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www.mccartycompany.com

# Project Manual

## Construction Documents

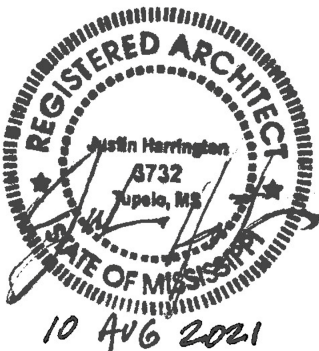
### FINE ARTS BUILDING RENOVATION

Itawamba Community College  
Fulton, MS

ICC Bid File #3451  
Architect's Project #19048

AUGUST 2021

This project consists of interior renovations of the existing Fine Arts Building on the Fulton campus of Itawamba Community College. Area of work is approximately 16,700 sq ft. Primarily replacement of interior finishes, the project also includes electrical, plumbing and HVAC upgrades, audio/video equipment and performance lighting.



ARCHITECTURE • PLANNING • INTERIOR DESIGN



**TABLE OF CONTENTS****DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS**

00 0107	SEALS PAGE
00 1113	ADVERTISEMENT FOR BID
00 1115	LIST OF DRAWING SHEETS
00 2113	INSTRUCTIONS TO BIDDERS
00 4113	BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)
00 4313	BID SECURITY FORMS
00 6000	PROJECT FORMS
00 6500	CERTIFICATE OF INSURANCE INSTRUCTIONS CERTIFICATE OF INSURANCE
00 7000	GENERAL CONDITIONS
00 8000	SUPPLEMENTARY CONDITIONS

**DIVISION 01 - GENERAL REQUIREMENTS**

01 1000	SUMMARY
01 2100	ALLOWANCES
01 2600	CONTRACT MODIFICATION PROCEDURES
01 2900	PAYMENT PROCEDURES
01 3100	PROJECT MANAGEMENT AND COORDINATION
01 3200	CONSTRUCTION PROGRESS DOCUMENTATION
01 3300	SUBMITTAL PROCEDURES
01 4000	QUALITY REQUIREMENTS
01 4200	REFERENCES
01 5000	TEMPORARY FACILITIES AND CONTROLS
01 6000	PRODUCT REQUIREMENTS
01 7300	EXECUTION
01 7700	CLOSEOUT PROCEDURES
01 7823	OPERATION AND MAINTENANCE DATA
01 7839	PROJECT RECORD DOCUMENTS
01 7900	DEMONSTRATION AND TRAINING

**DIVISION 02 – EXISTING CONDITIONS**

02 4119	SELECTIVE DEMOLITION
---------	----------------------

**DIVISION 05 – METALS**

05 5000	METAL FABRICATIONS
05 5213	PIPE AND TUBE RAILINGS

**DIVISION 6 – WOOD AND PLASTICS**

062023	INTERIOR FINISH CARPENTRY
064116	PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

**DIVISION 08 – OPENINGS**

08 1476	BIFOLDING WOOD DOORS
08 8000	GLAZING

**DIVISION 09 – FINISHES**

09 2216	NON-STRUCTURAL METAL FRAMING
09 2900	GYPSUM BOARD
09 3013	TILING
09 5113	ACOUSTIC PANEL CEILINGS
09 6513	RESILIENT BASE AND ACCESSORIES
09 6519	RESILIENT TILE FLOORING
09 8319	ACOUSTICAL WALL PANELS
09 9123	INTERIOR PAINTING

**DIVISION 10 – SPECIALTIES**

10 1423	PANEL SIGNAGE
10 2113	TOILET COMPARTMENTS
10 2800	TOILET AND BATH ACCESSORIES
10 5200	FIRE PROTECTION SPECIALTIES

**DIVISION 22 - PLUMBING**

220515	BASIC PLUMBING MATERIALS AND METHODS
220519	METERS AND GAGES FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220719	PLUMBING PIPING INSULATION
221116	DOMESTIC WATER PIPING
221316	SANITARY WASTE AND VENT PIPING
224213	COMMERCIAL WATER CLOSETS
224700	PLUMBING SPECIALTIES

**DIVISION 23 - HEATING VENTILATION AND AIR CONDITIONING**

230515	BASIC HVAC MATERIALS AND METHODS
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230713	DUCT INSULATION
230719	HVAC PIPING INSULATION
230800	COMMISSIONING OF HVAC
230930	AIRFLOW SENSORS AND TRANSMITTERS
232300	REFRIGERANT PIPING
233113	METAL DUCTS
233300	DUCT ACCESSORIES
233423	HVAC POWER VENTILATORS
233713	DIFFUSERS, REGISTERS, AND GRILLES
234100	PARTICULATE AIR FILTRATION
238127	DUCTLESS SPLIT-SYSTEM AIR-CONDITIONING UNITS

**DIVISION 26 - ELECTRICAL**

260501	BASIC ELECTRICAL MATERIALS AND METHODS
260519	CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING
260532	RACEWAYS AND BOXES

260923	LIGHTING CONTROLS
262200	LOW VOLTAGE TRANSFORMERS
262416	PANELBOARDS
262726	WIRING DEVICES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
263323	CENTRAL BATTERY EQUIPMENT FOR EMEGENCY LIGHTING
265100	INTERIOR LIGHTING
265561	THEATRICAL LIGHTING SYSTEM
266100	ELECTRICAL SYSTEM COMMISSIONING

**DIVISION 27 - COMMUNICATIONS**

270528	OWNER FURNISHED COMMUNICATIONS SYSTEMS
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**DIVISION 28 -ELECTRONIC SAFETY & SECURITY**

283111	ADDRESSABLE FIRE ALARM SYSTEM
289000	AUDIO VISUAL SYSTEMS

END OF TABLE OF CONTENTS



SECTION 000107 - SEALS PAGE

PART 1 - Seals Page

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. McCarty Architects Professional Association
2. Justin Harrington, Architect
3. MS License #3732.
4. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.

B. Mechanical Engineer: Fire-Protection / Plumbing / HVAC:

1. Corbett Legge & Associates, PLLC
2. Henry J Benjamin, PE
3. MS License #18881
4. Responsible for Division 22 and 23 Sections.

C. Electrical Engineer:

1. Corbett Legge & Associates, PLLC
2. Joseph Legge, PE
3. MS License #15189
4. Responsible for Division 26 and 27 Sections.

END OF SECTION 000107

## NOTICE TO BIDDERS

Sealed bids will be received at the business office in the Administration Building, 602 West Hill Street, Fulton, Mississippi 38843 until 10:00 a.m. on September 9, 2021, for:

**Bid File #3451  
Fine Arts Building Renovation  
Itawamba Community College  
Fulton, Mississippi**

Following the submission, bids will be opened publicly at the Fulton Campus Student Services Building, Executive Board Room (2<sup>nd</sup> Floor).

McCarty Architect's Project Number: 2019048

Bid documents are being made available via original paper copy or electronically. Planholders are required to log-in or register for an account at [www.mccartycompanyplans.com](http://www.mccartycompanyplans.com) to view and order Bid Documents. All planholders are required to have a valid email address for registration. Bid documents are non-refundable and must be purchased through the website. Questions regarding website registration and online orders please contact Plan House Printing at (662) 407-0193.

A pre-bid meeting will take place on August 31, 2021, at 10:00 am in the Fulton Campus Student Services Building, Executive Board Room (2<sup>nd</sup> Floor). All interested parties are encouraged to attend.

Bid preparation will be in accordance with Section 002113 – Instructions to Bidders, bound in the Project Manual.

**Bids may be submitted electronically by following instructions at this link:**  
[www.mccartycompanyplans.com](http://www.mccartycompanyplans.com)

Itawamba Community College is an Equal Opportunity Employer, and hereby notifies all Bidders will be afforded the full opportunities to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, religion, sex, national origin, age, disability, sexual preference, marital or veteran status, or any other legally protected status in consideration for an award.

**BID GUARANTEE:** Proposals shall be submitted with Proposal Security in the form of Certified Check or acceptable Bid Bond in an amount equal to at least five percent (5%) of the base bid; such security is to be forfeited as liquidated damages, not penalty, by any bidder who fails to carry out the terms of the proposal. The Bid Bond, if used, shall be payable to the Owner. Bonds on the project must be received on or before the period scheduled for the project and no bid may be withdrawn after the scheduled closing time for the project. Bids must be firm for a period of sixty (60) days after the scheduled time of opening.

**PERFORMANCE-PAYMENT BOND:** A 100% Performance-Payment Bond issued by a surety company authorized to do business in the State of Mississippi will be required within ten (10) days after the successful bidder has been notified of the award of the contract to him.



**CERTIFICATE OF RESPONSIBILITY:** All bids submitted by a prime or subcontractor for public works or public projects where said bid is in excess of fifty thousand dollars (\$50,000) to perform contracts enumerated in Section 31-3-21, Mississippi Code of 1972, shall contain on the outside or exterior of the envelope or container of such bid the contractor's current certificate number. No bid shall be opened or considered unless such contractor's current certificate number appears on the outside or exterior of said envelope or container or unless there appears a statement on the outside or exterior of such envelope or container to the effect that the bid enclosed therewith does not exceed fifty thousand dollars (\$50,000). When bids are submitted electronically, the requirement for including a certificate of responsibility, or a statement that the bid enclosed does not exceed Fifty Thousand Dollars (\$50,000.00), on the exterior of the bid envelope shall be deemed in compliance by including the same information as an attachment with the electronic bid submittal.

The Owner reserves the right to reject any or all bids and to waive irregularities.

Publish:           Tuesday, August 10, 2021  
                          Tuesday, August 17, 2021



## DOCUMENT 001115 - LIST OF DRAWING SHEETS

## 1.1 LIST OF DRAWINGS

- A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set dated August 2021 as modified by subsequent Addenda and Contract modifications.
- B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:

GENERAL

G000 COVER SHEET  
G001 GENERAL INFORMATION / LIFE SAFETY PLAN

ARCHITECTURAL

D101 DEMOLITION REFERENCE FLOOR PLAN  
D102 ENLARGED DEMOLITION FLOOR PLANS  
D103 ENLARGED DEMOLITION FLOOR PLANS  
D401 DEMOLITION REFERENCE REFLECTED CEILING PLAN  
D402 ENLARGED DEMOLITION REFLECTED CEILING PLANS  
D403 ENLARGED DEMOLITION REFLECTED CEILING PLANS  
A101 REFERENCE FLOOR PLAN  
A102 ENLARGED DEMOLITION FLOOR PLANS  
A103 ENLARGED DEMOLITION FLOOR PLANS  
A401 REFERENCE REFLECTED CEILING PLAN  
A402 ENLARGED REFLECTED CEILING PLANS  
A403 ENLARGED REFLECTED CEILING PLANS  
A601 INTERIOR ELEVATIONS  
A602 INTERIOR ELEVATIONS  
A603 INTERIOR ELEVATIONS

MECHANICAL

MD101 MECHANICAL DEMOLITION PLAN  
M101 MECHANICAL RENOVATION PLAN

ELECTRICAL

E001 ELECTRICAL LEGENDS AND DETAILS  
E002 ELECTRICAL SCHEDULES  
E100 ELECTRICAL DEMOLITION PLAN  
E101 POWER PLAN  
E201 LIGHTING PLAN  
E401 SYSTEMS PLAN  
E402 AV AND THEATRICAL LIGHTING PLAN  
E501 ELECTRICAL RISER DIAGRAM  
E601 ELECTRICAL PANEL SCHEDULES

END OF DOCUMENT



**DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS**

**PART 1 - GENERAL**

**1.1 INSTRUCTIONS TO BIDDERS**

- A. AIA Document A701, "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.

**1.2 QUESTIONS**

- A. Questions should be directed to McCarty Architects. Should a Bidder find discrepancies in, or omissions from the plans and specifications, or be in doubt as to their meaning, the Bidder should immediately notify McCarty Architects in writing. McCarty Architects will send written instruction(s) or interpretation(s) to all known holders of the documents. Neither the Owner nor the Design Professional will be responsible for nor bound by any oral instruction or interpretation. Contact: Justin Harrington, Architect, (jharrington@mccartycompany.com). Phone: 662-844-4400, Fax: 662-844-0500.
- B. Any addenda to the plans and/or specifications issued before or during the time of bidding will become a part of the Contract and receipt of same must be acknowledged by Bidder in his proposal. Failure to acknowledge all addenda may cause Bidder's proposal to be rejected as nonresponsive.

**1.3 BIDDER'S QUALIFICATIONS**

- A. The Owner may make such investigation as he deems necessary to determine the ability of the Bidder or subcontractors or suppliers to perform the Work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and/or to complete the work contemplated therein within the time required.
- B. The Bidder is specifically advised that any person, firm or other party to whom it proposes to award a subcontract or purchase order under this Contract must be acceptable to the Owner.

**1.4 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:**

- A. Copy of Law: If the non-resident Bidder's state has a resident Bidder preference law, a copy of that 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.

#### 1.5 CERTIFICATE OF RESPONSIBILITY

- A. Each Bidder submitting a bid in excess of \$50,000.00 on public projects must show on his bid and on the face of the envelope containing the bid, his Certificate of Responsibility Number, as required by Section 31-3-5 and 31-3-21 (latest edition) Mississippi Code of 1972. If the bid does not exceed the amount of \$50,000.00 on public projects, a notation so stating must appear on the face of the envelope.

When multiple contractors submit a joint venture bid in excess of \$50,000.00 on public projects, a Joint Venture Certificate of Responsibility Number is required on the bid and face of the envelope. If the Joint Venture has no Joint Venture Certificate of Responsibility number, then each member of the Joint Venture must indicate their individual Certificate of Responsibility numbers on the bid and on the face of the envelope.

- B. Each Subcontractor who's Subcontract exceeds \$50,000.00 on public projects shall have a Certificate of Responsibility Number, as required by Section 31-3-15 and 31-3-21 (latest version), Mississippi Code.
- C. No bid will be opened, considered or accepted unless the above information is given as specified. Sufficient evidence that said Certificate of Responsibility has been issued and is in effect at the time of receiving bids must be submitted when required by the Owner or the Architect. Likewise, it shall be the responsibility of the Prime Contractor to require a Certificate of Responsibility Number from any subcontractor where applicable.

- 1.7 PERFORMANCE BOND: On construction projects that exceed twenty-five thousand dollars (\$25,000.00), a Performance Bond is required. The performance bond must be issued through a licensed MS agent and will be made a part of the construction contract agreement. See Section 00600 Contract Bonds.

- 1.8 TAX ON CONSTRUCTION: It is incumbent upon the bidder to be familiar with the laws of the state concerning tax on construction. Although the College is excluded from paying most taxes, Section 27-65-21 of the Mississippi Code of 1972 covers sales tax chargeable to contractors.

- 1.9 DISQUALIFICATION OF BIDDER: The Owner reserves the right to award to other than the low Bidder when, in the Owner's judgment, it is in his best interest to do so. A Bidder may be disqualified for such reasons as:

- A. Bidder's failure to comply with requirements regarding Certificates of Responsibility.
- B. Bidder's failure to sign Bidder's Proposal Form, Section 00 41 13, or to otherwise properly complete the Proposal Form.
- C. Bidder being in arrears on existing contracts with the College or any other state agency.

- D. Bidder being in dispute or litigation with the College or any other state agency.
- E. Bidder having defaulted on a previous contract with the College or any other state agency.
- F. Bidder having performed unsatisfactorily on a previous contract, including but not limited to the Bidder's failure to fulfill the warranty obligations of a previous contract with the Owner.

The above is not an inclusive list.

- 1.11 **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.
- 1.12 **EXAMINATION OF SITE:** All Bidders, including subcontractors, shall visit the Project site, compare the plans and specifications 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 the plans and specifications without additional cost to the Owner.
- 1.13 **LAWS AND REGULATIONS:** The Bidder must comply with applicable laws, rules and regulations of all authorities having jurisdiction over the Project at no additional costs to the Owner whether such laws, ordinances, rules and regulations are adopted or enacted before or after bid opening.
- 1.14 **OBLIGATION OF BIDDER:** At the bid opening, each Bidder will be presumed to have inspected the site, read and become thoroughly familiar with the plans and specifications, including all addenda.
- 1.15 Bidders will be provided one (1) set of Contract Documents. Contract Documents are to be returned by the unsuccessful Bidders within ten (10) days after award of contract.
- 1.16 **PRE-BID CONFERENCE:** Pre-bid conference will be held on the date and at the location specified on the Advertisement for Bids.

**PART 2 - PROPOSAL FORM**

- 2.1 **METHOD OF BIDDING:**
  - A. Lump sum bids received from General Contractors which shall include general, mechanical, electrical and site work as well as other work shown on and reasonably inferable from the plans and specifications.
- 2.2 **PROPOSAL FORMS:** The Bidder shall submit its proposal in duplicate on forms provided and shall fill all applicable blank spaces without interlineation or alteration and must not restate the

work to be done. Forms must be typed or written in ink and any alterations to bid prices must be initialed. No oral proposals will be considered.

All received bid proposals shall be binding for a minimum of sixty (60) days from bid date.

By submission of its bid, Bidder agrees to commence work on or before the date specified in a written notice to proceed and to fully complete the work within the time stated in the bid proposal form.

2.3 ALTERNATES: 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.

2.4 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.

2.5 BIDDER IDENTIFICATION

A. Signature: The Proposal Form shall be signed in ink by any individual authorized to bind the Bidder.

B. Name of Bidder: The name appearing on the Proposal Form should be the same as the name appearing in the current Mississippi State Board of Contractors Roster.

C. Legal Address: The address appearing on the Proposal Form should be the same address appearing in the current Mississippi State Board of Contractors Roster.

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.

2.6 BID SECURITY: The Bid Security, which must accompany each Bid, 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, the Surety and a Mississippi resident agent. (No standard form is required for the Bid Bond.)

B. Certified Check: The Bidder may submit a certified check payable to Owner 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 ninety (90) days, unless a Contract is awarded and executed in less time. Personal and company checks that are not bank encumbered are not acceptable bid securities.

C. Bids received that do not accompany the Bid Security will not be considered.

2.7 POWER OF ATTORNEY: Each bid bond must be accompanied by an appropriate Power of Attorney.



## PART 3 - SUBMITTING THE PROPOSAL FORM

## 3.1 BID FORM:

- A. Bids shall be submitted on forms identical to the form included with the Bidding Documents, in the quantity required by Article 2.2 in these Instructions.
- B. All blanks on the bid form shall be filled in by typewriter or manually in ink.
- C. Where so indicated by the makeup of the bid form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the amount written in words shall govern.
- D. Any interlineation, alteration or erasure must be initialed by the signer of the Bid.
- E. All requested alternates shall be bid. If no change in the Base Bid is required, enter "No Change."
- F. Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of his bid security, state his refusal to accept award of less than the combination of Bids he so stipulates. The Bidder shall make no additional stipulations on the bid form nor qualify his Bid in any other manner.
- G. Each copy of the Bid shall include the legal name of the Bidder and a statement that the Bidder is a sole proprietor, a partnership, a corporation or some other legal entity. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state in incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

3.2 MAILED BIDS: If the Bid is mailed, the bid envelope shall be placed inside a second envelope to prevent inadvertent premature opening of the Proposal.

3.3 ELECTRONIC BIDS: Bids may be submitted electronically by following instructions at this link: <https://www.mccartycompanyplans.com>

3.4 MODIFICATION TO BID: A modification or qualification to the bid written on the outside of the sealed envelope containing the bid will be accepted. The change will be read aloud prior to the bid envelope being publicly opened. The Agent of the company that modified the bid on the sealed envelope must initial and date the modification. A facsimile modification will not be accepted.

3.5 WITHDRAWAL OF BID: Any bid may be withdrawn prior to the scheduled time for opening of bids or authorized postponement of same. Any bid received after the date and time specified will not be considered. However, bids received at the scheduled time constitute irrevocable offers to contract at the price in the bid and may not be withdrawn until sixty (60) days after opening of

bids. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

#### PART 4 - BID OPENING AND AWARD OF CONTRACT

- 4.1 OPENING OF BIDS: Bids will be opened at the time stated in the Advertisement for Bids. Bidder representatives will be provided a summary of bid results for review after the bid opening.
- A. All construction bids have a written published bid opening time and date assigned that is the drop-dead time for us to receive your sealed bid. All bids received are time stamped or clocked in using our time clock. There is no other time clock that will be considered. It is your responsibility to make sure you or your carrier is aware of the published deadline for each bid. **Bids that are late by one (1) second are rejected.** Failure of Fed-Ex, UPS or the USPS to deliver your bids on time is not the College's responsibility. Bids will be opened publicly at the time and place stated in the invitation for bids. The officer whose duty is to open them will decide when the specified time has arrived and no bid received thereafter will be considered. No responsibility will be attached to any officer for the premature opening of a bid not properly addressed and identified.
- 4.2 IRREGULARITIES: The omission of any information requested on the Proposal Form may be considered as an informality, or irregularity, by the Owner when in his opinion the omitted information does not alter the amount contained in the submitted bid proposal or place other Bidders at a disadvantage.
- 4.2 IRREGULARITIES: The omission of any information requested on the Proposal Form may be considered as an informality, or irregularity, by the Owner when in his opinion the omitted information does not alter the amount contained in the submitted bid proposal, or place other Bidders at a disadvantage.
- 4.3 PROTEST: Any protest must be delivered in writing to the Owner within twenty-four (24) hours after the time of the bid opening.
- 4.4 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 provide sufficient documentation with the written request clearly proving an error was made and the Bidder's intended bid.
- 4.5 AWARD OF CONTRACT: The Owner reserves the right to reject any or all bids and to waive any and all irregularities. If awarded, a contract will be awarded, as soon as possible, to a responsible Bidder whose responsive bid proposal is the lowest and best bid, provided the bid is reasonable and it is to the best interest of the Owner to accept it.
- 4.6 FAILURE TO ENTER INTO A CONTRACT: The Bidder shall forfeit the Bid Security to the Owner as liquidated damages for failure, or refusal, to execute and deliver the Contract, Bond and Certificate of Insurance within the required ten (10) days after notice of the acceptance of the bid.
- 4.7 SECURITY FOR FAITHFUL PERFORMANCE: Simultaneously with delivery of the executed Contract, the Contractor will furnish Performance and Payment 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 Bonds will be a duly authorized surety company licensed to do business in Mississippi and 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.
  - 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 acceptable to Owner.
  - D. All Bonds shall be countersigned by a Mississippi resident agent with the name and address typed, or lettered legibly.
  - E. All Bonds must be accompanied by an appropriate Power of Attorney.
- 4.8 INSURANCE: Prior to beginning work, a Certificate of Insurance must be delivered to the Owner. See Project Specifications for requirements.
- 4.9 OWNER RESERVES THE RIGHT TO REJECT ANY OR ALL BIDS AND TO WAIVE INFORMALITIES.

PART 5 - BIDDER'S CHECKLIST

A. PROPOSAL FORM

Base Bid

Write in the amount of the base bid in words and numbers.

Alternate(s)

Write in the amount of alternate bid(s) in words and numbers.

Addenda

Acknowledge the receipt of each addendum by writing in the number of the addendum and the date received.

Acceptance

Proposal is signed by authorized person

Name of Business as it appears in the current Mississippi State Board of Contractors Roster

Legal address of the business listed above

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

Certificate of Responsibility Number(s)

Base Bid is under \$50,000 for public projects and no number is required

Base Bid is under \$50,000 for public projects and the statement "bid does not exceed \$50,000 on public projects is on the outside of the bid envelope

Base Bid is over \$50,000.00 on public projects and number is required

Joint Venture and *joint venture* number is required

or

Joint Venture participants' numbers are required

B. BID SECURITY

Included Bid Bond

or

Included Certified Check

C. POWER OF ATTORNEY

Included Power of Attorney for Bid Bond

END OF DOCUMENT 002113

**DOCUMENT 004113 - BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)**

**1.1 BID INFORMATION**

- A. Bidder: \_\_\_\_\_.
- B. Project Name: Fine Arts Building Renovation
- C. Project Location: Fulton, Mississippi
- D. Owner: Itawamba Community College
- E. Architect: McCarty Architects, P.A.
- F. Architect Project Number: 2019048

**1.2 CERTIFICATIONS AND BASE BID**

- A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by McCarty Architects, P.A. and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

Base Bid –

\_\_\_\_\_

\_\_\_\_\_ Dollars (\$\_\_\_\_\_).

- B. ALLOWANCES: The undersigned Bidder certifies that Base Bid submission includes those allowances described in the Contract Documents and scheduled in Section 012100 "Allowances."

**1.3 BID GUARANTEE**

- A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within 10 days after a written Notice of Award, if offered within sixty (60) days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5%) of the Base Bid amount above:

1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).

- B. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

**1.4 TIME OF COMPLETION**

- A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Architect and shall fully complete the Work within 150 days of the date of that Notice.
- B. Liquidated Damages: \$500.00 per calendar day.

**1.5 ACKNOWLEDGEMENT OF ADDENDA**

- A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:
  - 1. Addendum No. 1, dated \_\_\_\_\_.
  - 2. Addendum No. 2, dated \_\_\_\_\_.
  - 3. Addendum No. 3, dated \_\_\_\_\_.
  - 4. Addendum No. 4, dated \_\_\_\_\_.

**1.6 BID SUPPLEMENTS**

- A. The following supplements are a part of this Bid Form and are attached hereto.
  - 1. Bid Form Supplement - Bid Bond Form (AIA Document A310).

**1.7 CONTRACTOR'S LICENSE**

The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in Mississippi, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

1.8 SUBMISSION OF BID

Respectfully submitted this \_\_\_\_ day of \_\_\_\_\_, 2020.

Submitted By: \_\_\_\_\_  
(Name of bidding firm or corporation)

Authorized  
Signature: \_\_\_\_\_  
(Handwritten signature)

Signed By: \_\_\_\_\_  
(Type or print name)

Title: \_\_\_\_\_  
(Owner/Partner/President/Vice President)

Witness By: \_\_\_\_\_  
(Handwritten signature)

Attest: \_\_\_\_\_  
(Handwritten signature)

By: \_\_\_\_\_  
(Type or print name)

Title: \_\_\_\_\_  
(Corporate Secretary or Assistant Secretary)

Street Address: \_\_\_\_\_

City, State, Zip \_\_\_\_\_

Phone: \_\_\_\_\_

License No.: \_\_\_\_\_

Federal ID No.: \_\_\_\_\_

(Affix Corporate Seal Here)

END OF DOCUMENT 004113





DOCUMENT 004313 - BID SECURITY FORMS

1.1 BID FORM SUPPLEMENT

- A. A completed bid bond form is required to be attached to the Bid Form.

1.2 BID BOND FORM

- A. AIA Document A310, "Bid Bond," is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.
- B. Copies of AIA standard forms may be obtained from The American Institute of Architects; [www.aia.org/contractdocs/purchase/index.htm](http://www.aia.org/contractdocs/purchase/index.htm); email: [docspurchases@aia.org](mailto:docspurchases@aia.org); (800) 942-7732.

END OF DOCUMENT 004313



**DOCUMENT 006000 - PROJECT FORMS****1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS**

- A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:
1. AIA Document A101, "Standard Form of Agreement between Owner and Contractor, Stipulated Sum."
  2. The General Conditions of the Contract for Construction, AIA Document A201, 2017 Edition, Articles 1 through 14 inclusive, is a part of this Contract and is incorporated herein as fully as if here set forth. Contractors are presumed to be familiar with this document; however, a copy may be examined in the Architect's office.
  3. The Supplementary Conditions for Project are separately prepared and included in the Project Manual.

**1.2 ADMINISTRATIVE FORMS**

- A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements Sections.
- B. Copies of AIA standard forms may be obtained from the following:
1. The American Institute of Architects: [www.aia.org/contractdocs/purchase/index.htm](http://www.aia.org/contractdocs/purchase/index.htm); [docspurchases@aia.org](mailto:docspurchases@aia.org); (800) 942-7732.
- C. Preconstruction Forms:
1. Form of Performance Bond and Labor and Material Bond: AIA Document A312, "Performance Bond and Payment Bond."
  2. Form of Certificate of Insurance: Bound in this Project Manual.
- D. Information and Modification Forms:
1. Form for Requests for Information (RFIs): AIA Document G716, "Request for Information (RFI)."
  2. Form of Request for Proposal: AIA Document G709, "Work Changes Proposal Request."
  3. Change Order Form: AIA Document G701, "Change Order."
  4. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G707, "Architect's Supplemental Instructions."
  5. Form of Change Directive: AIA Document G714, "Construction Change Directive."

**E. Payment Forms:**

1. Schedule of Values Form: AIA Document G703, "Continuation Sheet."
2. Payment Application: AIA Document G702/703, "Application and Certificate for Payment and Continuation Sheet."
3. Form of Contractor's Affidavit: AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
4. Form of Affidavit of Release of Liens: AIA Document G706A, "Contractor's Affidavit of Payment of Release of Liens."
5. Form of Consent of Surety: AIA Document G707, "Consent of Surety to Final Payment."

END OF DOCUMENT 006000

## SECTION 006500 CERTIFICATE OF INSURANCE INSTRUCTIONS

- A. 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, 2017 edition).
- B. The *Certificate of Insurance* must be completed, certified by the original signature of a Mississippi Resident Insurance Agency and bound in each set of the Contract Documents.
- C. Indicate Insured, Project, Companies providing coverage, policy numbers and policy periods in the blanks as applicable.
- D. 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.
- E. 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.
- F. OTHER INSURANCE (if required) will be indicated by typing in the “OTHER” block and detailed in Article 11 of the Supplementary Conditions.
- G. CERTIFICATION wording may not be changed without specific written approval from the Owner.
- H. “Riders” 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.
- I. 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.
- J. The Owner and Architect and all of their agents and employees are included as additional insureds on the Contractor’s insurance.

END OF SECTION 006500



**STANDARD CONSTRUCTION CONTRACT  
CERTIFICATE OF INSURANCE**

<b>INSURED:</b> (Contractor's Name & Address)				<b>COMPANIES PROVIDING COVERAGE</b>		
				A		
<b>PROJECT:</b> (Name & Location) Fine Arts Building Renovation Itawamba Community College, Fulton, Mississippi				B		
				C		
				D		
<b>OWNER:</b> Itawamba Community College				E		
				F		
				G		
Type Insurance	Co	Policy Number	Policy Period	Coverage and Minimum Amount		
General Liability Commercial General Liability				General Aggregate	\$ 2,000,000	
				Products Comp/Ops (Aggregate)	\$ 2,000,000	
				Personal Injury (Per Occurrence)	\$1,000,000	
				BI & PD (Per Occurrence)	\$1,000,000	
				Damage to Rented Premises (Per Fire)	\$ 100,000	
				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)	\$ 1,000,000	
				<b>OR</b>	Bodily Injury (Per Person)	\$ N/A
					Bodily Injury (Per Accident)	\$ N/A
					Property Damage (Per Occurrence)	\$ N/A
* Excess Liability (Umbrella on projects over \$500,000)				Aggregate	\$ 1,000,000	
				Per Occurrence	\$ 1,000,000	
Workers' Compensation (As required by Statute) Employers' Liability				Accident (Per Occurrence)	\$ 1,000,000	
				Disease-Policy Limit	\$ 500,000	
				Disease-Per Employee	\$ 100,000	
* Property Insurance				<b>OR</b>	Builders' Risk 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 Resident Agent; and (3) endorsed to require the company to give thirty (30) days written notice to the Owner prior to cancellation of non-renewal of above.						
<b>Producing Agent:</b> (Name, Address and Telephone)						
				(Signature & Date)		
				(Name and Title of Authorized Representative)		

Check if Mississippi Resident Agent \_\_\_\_\_  
OR Countersign by MS Resident Agent \_\_\_\_\_





SECTION 007000 - GENERAL CONDITIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: The General Conditions of the Contract for Construction, AIA Document A201, 2017 Edition, Articles 1 through 14 inclusive, is a part of this Contract and is incorporated herein as fully as if here set forth. Contractors are presumed to be familiar with this document; however, a copy may be examined in the Architect's office.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 007000



**DOCUMENT 008000 - SUPPLEMENTARY CONDITIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The following Supplementary Conditions modify the "General Conditions of the Contract for Construction," AIA Document A201, 2017. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect. In the event of a conflict between the General Conditions of the Contract for Construction and Section 008000, Section 008000 shall control even if the conflicting provision in the General Conditions of the Contract for Construction is not expressly revised or deleted by reference in Section 008000.
- B. The General Conditions may also be supplemented or amplified elsewhere in the Contract Documents by provisions located in, but not necessarily limited to, Division 1 of the Specifications.

**1.2 SUPPLEMENTS**

**A. ARTICLE 1 – GENERAL PROVISIONS**

**1. ARTICLE 1.1 – THE CONTRACT DOCUMENTS:**

- a. **ARTICLE 1.1.1:** Delete the last sentence in Article 1.1.1 and insert the following:

The Contract Documents shall include the Instructions to Bidders, the plans, the specifications, including Divisions 1 through 32, all Addenda and modifications to the plans and/or specifications, the Agreement between Owner and Contractor, the performance and payment bonds, the notice to proceed and any executed change orders. Information and documentation pertaining to soil investigation data, laboratory investigations, soil borings and related information included herein are not part of the Contract Documents. In the event of a conflict between the provisions of Division O and any other section of the Contract Documents, such other sections(s) shall govern.

- b. **ARTICLE 1.1.2 – THE CONTRACT:** Add the following to the end of Article 1.1.2:

Large scale drawings shall govern over small scale drawings where there are differences or conflicts between such drawings. Where the word similar appears on the plans, it shall not be interpreted to mean identical and shall require the Contractor to coordinate the actual conditions and dimensions of the location where the similar conditions are shown to occur.

- c. ARTICLE 1.1.9 – MISCELLANEOUS DEFINITIONS: Add the following to Article 1.1.9:

The term "products" as used in these Supplementary Conditions includes materials, systems and equipment.

2. ARTICLE 1.2 – CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS:

- a. ARTICLE 1.2.4: Add the following Article 1.2.4:

It is the intent of the Contract Documents that the Contractor shall properly execute and complete the Work described by the Contract Documents, and unless otherwise provided in the Contract, the Contractor shall provide all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services, whether temporary or permanent and whether or not incorporated in the Work, in full accordance with the Contract Documents and reasonably inferable from them as necessary to produce the intended results.

- b. ARTICLE 1.2.5: Add the following Article 1.2.5:

The Contract Documents shall be interpreted collectively, each part complementing the others and consistent with the intent of the Contract Documents. Unless an item shown or described in the Contract Documents is specifically identified to be furnished or installed by the Owner or others or is identified as Not In Contract (N.I.C.), the Contractors obligation relative to that item shall be interpreted to include furnishing, assembling, installing, finishing, and/or connecting the item at the Contractors expense to produce a product or system that is complete, appropriately tested, and in operable condition ready for use or subsequent construction or operation by the Owner or separate contractors. The omission of words or phrases for brevity of the Contract Documents, the inadvertent omission of words or phrases, or obvious typographical or written errors shall not defeat such interpretation as long as it is reasonably inferable from the Contract Documents as a whole.

Words or phrases used in the Contract Documents which have well-known technical or construction industry meanings are to be interpreted consistent with such recognized meanings unless otherwise indicated.

Except as noted otherwise, references to standard specifications or publications of associations, bureaus, or organizations shall mean the latest edition of the referenced standard specification or publication as of the date of the Advertisement of Bids.

In the case of inconsistency between Drawings and Specifications or within either document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Architects interpretation.

Generally, portions of the Contract Documents written in longhand take precedence over typed portions, and typed portions take precedence over printed portions.

Any doubt as to the meaning of the Contract Documents or any obscurity as to the wording of them, shall be promptly submitted in writing to the Architect for written interpretation, explanation, or clarification.

3. ARTICLE 1.6 – TRANSMISSION OF DATA IN DIGITAL FORM: Delete the phrase in Article 1.6 they shall endeavor to in the second line and insert the phrase the Architect shall and add the following to the end of the sentence:

which protocols shall be the same as or similar to the Digital Data Protocol Exhibit, AIA Doc. E201-2017.

B. ARTICLE 2 – OWNER

1. ARTICLE 2.2 – INFORMATION AND SERVICES REQUIRED OF THE OWNER:

- a. ARTICLE 2.2.1: Add the following to the beginning of Article 2.2.1:

If the Project is a private project, not funded by public funds, then . . .

- b. ARTICLE 2.2.2: Delete Article 2.2.2 in its entirety.
- c. ARTICLE 2.2.3: Delete Article 2.2.3 in its entirety.
- d. ARTICLE 2.2.5: Delete Article 2.2.5 in its entirety and insert the following:

**NOTE:**

2.2.5 The Contractor will be furnished free of charge 10 copies of the plans and specifications, including all Addenda. Additional sets will be furnished at the cost of reproduction, postage and handling.

2. ARTICLE 2.3 – OWNERS RIGHT TO STOP WORK: Delete Article 2.3 in its entirety and insert the following:

If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents as required by Article 12.2 or fails to carry out Work in accordance with the Contract Documents or fails to perform any of its obligations under the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated. However, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Article 6.1.3.

The rights and remedies under this Article 2.3 are in addition to and do not in any respect limit any other rights of the Owner, including its termination rights under Article 14.

## C. ARTICLE 3 – CONTRACTOR

1. ARTICLE 3.1.1 – GENERAL: Add the following at the end of Article 3.1.1:

The relationship of Contractor to Owner shall be that of independent contractor, and nothing in the Contract Documents is intended to nor should it be construed as creating any other relationship, expressed or implied, between Owner and Contractor.

2. ARTICLE 3.2.5 – REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR: Add the following Article 3.2.5:

The Owner is entitled to deduct from the Contractors pay applications for amounts paid to the Architect for evaluating and responding to the Contractors requests for information that are not prepared in accordance with the Contract Documents or where the requested information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

3. ARTICLE 3.4 – LABOR AND MATERIALS:

- a. ARTICLE 3.4.2: Add the following to the end of Article 3.4.2:

Some Sections of the Specifications may not allow substitution of materials, products or equipment. Where substitution is allowed the request for substitution will only be considered if made in strict accordance with the requirements of Article 3.4.4 below and Section 01600.

- b. ARTICLE 3.4.4: Add the following Article 3.4.4:

After the Contract has been executed, the Owner and the Architect may consider a request for the substitution of products in place of those specified only under the conditions set forth in Section 01600 of the specifications.

By making requests for substitutions, the Contractor:

- .1 Represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respect to that specified;
- .2 Represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified;
- .3 Certifies that the cost data presented is complete and includes all related costs under this Contract except the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently becomes apparent; and
- .4 Shall coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects at its costs.

All substitutions shall be submitted within 30 days of the Notice to Proceed, as per Section 016000.

- c. ARTICLE 3.4.5: Add the following Article 3.4.5:

Contractor represents that it has independently investigated, considered and understands the labor conditions in the area surrounding the Project and acknowledges that such conditions may impact the Contractors cost and/or time of performance of the Contract. Therefore, Contractor further represents that the Contract Price is based upon Contractors independent investigations into such labor conditions and that the Contract time is reasonable and the date of Substantial Completion is obtainable. As a result, Contractor assumes the risk of increased costs, if any, incurred by it arising out of or related to such labor conditions and acknowledges that Contractor and its surety will reimburse Owner for any additional costs Owner incurs arising out of or related to such labor conditions.

4. ARTICLE 3.7 – PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS:

- a. ARTICLE 3.7.1: Delete Article 3.7.1 in its entirety and insert the following:

The Contractor shall secure and pay for the building permit and all other permits, fees, licenses, inspections and all other approvals and charges necessary for proper execution and completion of the Work.

- b. ARTICLE 3.7.3: Delete the words knowing it to be from Article 3.7.3.

5. ARTICLE 3.8.2.3: Add the following to the end of Article 3.8.2.3:

. . . except when installation is specified to be included as part of the allowance in the General Requirements (Division 1 of the Specifications).

6. ARTICLE 3.10.3 – CONTRACTORS CONSTRUCTION SCHEDULES: Delete Article 3.10.3 in its entirety and insert the following:

Time being of the essence, the Contractor shall perform the Work in accordance with the most recent schedule submitted to and approved by the Owner and Architect.

7. ARTICLE 3.12 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES:

- a. ARTICLE 3.12.6: Add the following to the end of Article 3.12.6:

In reviewing Shop Drawings, Product Data, Samples and similar submittals the Architect shall be entitled to rely upon the Contractors representation that such information is correct and accurate.

- b. ARTICLE 3.12.8: Add the following to the end of Article 3.12.8:

Unless such written notice has been given, the Architects approval of a Shop Drawing, Product Data, Sample or similar submittal shall not constitute approval of any changes not requested on the prior submittal.

- c. ARTICLE 3.12.9: Add the following to the end of Article 3.12.9:

The Architects review of the Contractors submittals will be limited to examination of an initial submittal and one (1) resubmittal. The Architects review of additional submittals will be made only with the consent of the Owner after notification by the Architect. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for evaluation of such additional resubmittals.

8. ARTICLE 3.18.1 – INDEMNIFICATION: Make the following corrections to Article 3.18.1:

Add the word defend, before the word indemnify in the first line, add the words or nonperformance after the word performance in the third line and delete the phrase which begins provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), to the end of the sentence.

D. ARTICLE 4 – ARCHITECT

1. ARTICLE 4.1.1: Add the following at the end of Article 4.1.1:

**NOTE:**

The term "Architect", "Engineer" or "Design Professional" as used in the Contract Documents refers to **McCarty Architects, P.A.**

2. ARTICLE 4.2.10 –ADMINISTRATION OF THE CONTRACT: Delete Article 4.2.10 in its entirety.

E. ARTICLE 5 - SUBCONTRACTORS

1. ARTICLE 5.2.1 – AWARD OF SUBCONTRACTS AND OTHER PORTIONS OF THE WORK: Delete the phrase Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract from the first sentence of Article 5.2.1 and insert the following in lieu thereof:

The Contractor, with its first Application for Payment and as a condition to the Owners obligation to make payments to Contractor under Article 9 of the General Conditions as supplemented herein,□

2. ARTICLE 5.2.5: Add the following to Article 5.2.5:

The Contractors unauthorized substitution of any subcontractor, supplier, person or entity previously identified by Contractor in accordance with Article 5.2.1 shall entitle the Owner to reject the work, materials or product furnished and require removal and replacement at no additional cost to the Owner.



## F. ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

1. ARTICLES 6.1.1, 6.1.2, 6.1.3, 6.1.4 – OWNERS RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS: Delete Articles 6.1.1, 6.1.2, 6.1.3, 6.1.4 in their entirety and insert the following:

The Owner reserves the right to perform construction or operations related to the Project with the Owners own forces and to award separate contracts either in connection with other portions of the Project or other construction or operation on the site. In such event, the Contractor shall coordinate its activities with those of the Owner and of other contractors so as to facilitate the general progress of all work being performed by all parties. Cooperation will be required in the arrangement for the storage of materials, and in the detailed execution of the Work.

The Contractor, including his subcontractors, shall keep informed of the progress and the detailed work of the Owner or other contractors and shall immediately notify the Architect of lack of progress or delays by other contractors which are affecting Contractors Work. Failure of Contractor to keep informed of the progress of the work of the Owner or other contractors and/or failure of Contractor to give notice of lack of progress or delays by the Owner or other contractors shall be deemed to be acceptance by Contractor of the status of progress by other contractors for the proper coordination and completion of Contractors Work. If, through acts or neglect on the part of the Contractor, the Owner or any other contractors or subcontractor shall suffer loss or damage or assert any claims of whatever nature against the Owner, the Contractor shall defend, indemnify and hold harmless the Owner from any such claims or alleged damages, and the Contractor shall resolve such alleged damages or claims directly with the other contractors or subcontractors.

2. ARTICLE 6.2.3 – MUTUAL RESPONSIBILITY: Delete Article 6.2.3 in its entirety.

## G. ARTICLE 7 - CHANGES IN THE WORK:

1. ARTICLE 7.1.3 – GENERAL: Add the following to the end of Article 7.1.3:

Except as permitted in Article 7.3, a change in the Contract Sum or the Contract Time shall only be accomplished by written change order. Therefore, the Contractor acknowledges that it is not entitled to a change in the Contract Sum or the Contract Time in the absence of a written change order on the basis of the course of conduct or dealings between the parties and/or the Owners express or implied acceptance of alterations or additions to the Work and/or the Owner has been unjustly enriched by the Contractors Work or any other basis otherwise allowed by law or the facts and Contractor agrees that any such extra or changed work was performed by it as a volunteer.

2. ARTICLE 7.2 – CHANGE ORDERS:

- a. ARTICLE 7.2.2: Add the following Article 7.2.2:

Contractors execution of a change order constitutes a final settlement to the Contract Sum and construction schedule and the Contract Time for all matters relating to or arising out of the change in the Work that is the subject of the

change order including, but not limited to, all direct and indirect costs associated with such change, all extended direct job site and home office overhead expenses and any and all delay and impact cost for the change, whether alone or in combination with other changes, including any impact, ripple or cumulative effect resulting therefrom, if any.

b. ARTICLE 7.2.3: Add the following Article 7.2.3:

Adjustments to the Contract Sum by change order shall be based upon one of the methods set forth in Article 7.3.3.1, 7.3.3.2, 7.3.3.3 or 7.3.3.4, as appropriate. A reasonable allowance for the combined overhead and profit included in the change order shall be based upon the schedule set forth in Article 7.3.11, as supplemented.

c. ARTICLE 7.2.4: Add the following Article 7.2.4:

In order to facilitate consideration of change order requests, all such requests, except those involving an amount less than \$500 must be accompanied by a complete itemization of costs, including labor, materials and subcontractor costs which shall likewise be itemized. Changes for more than \$500 will not be approved without such itemization.

3. ARTICLE 7.3 – CONSTRUCTION CHANGE DIRECTIVES:

a. ARTICLE 7.3.8: Delete the first sentence and insert the following:

The amount of credit to be given by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be the actual net cost plus reasonable allowance for overhead on net cost and profit thereon as approved by the Architect and Owner.

b. ARTICLE 7.3.11: Add the following Article 7.3.11:

The allowance for overhead and profit combined, including extended direct job and home office overhead and any and all delay, impact, inefficiency, disruption and ripple effect to be included in the total cost to the Owner, shall be based on the following schedule:

- .1 For the Contractor, for work performed by the Contractor's own forces, 15 percent of the cost.
- .2 For the Contractor, for work performed by the Contractor's subcontractor, 10 percent of the amount due the subcontractor.
- .3 For each subcontractor or sub-subcontractor involved, for work performed by that subcontractor or sub-subcontractor's own forces, 15 percent of the cost.
- .4 For each subcontractor, for work performed by the subcontractor's sub-subcontractor's, 10 percent of the amount due the sub-subcontractor.
- .5 Costs to which overhead and profit is to be applied shall be determined in accordance with Article. 7.3.7.

## H. ARTICLE 8 - TIME

1. ARTICLE 8.2.1 – PROGRESS AND COMPLETION: Add the following to the end of the second sentence:  

and that the Contractor is fully capable of properly completing the Work within the Contract Time.
2. ARTICLE 8.3 – DELAYS AND EXTENSIONS OF TIME:
  - a. ARTICLE 8.3.1: Add the following to the end of Article 8.3.1:  

Abnormal adverse weather shall not be grounds for Contract Time extension
  - b. ARTICLE 8.3.3: Add the following to the end of Article 8.3.3:  

No delay, interference, hindrance or disruption, from whatever source or cause, in the progress of the Contractors Work shall be a basis for an extension of time and/or additional compensation, unless the delay, interference, hindrance or disruption (1) is without the fault and not the responsibility of the Contractor, its subcontractors and/or suppliers and (2) directly affects the overall completion of the Work as reflected on the critical path of the Contractors updated and accepted construction schedules. The Contractor expressly agrees that the Owner shall have the benefit of any float in the construction schedule and that delays to construction activities, which do not affect the overall completion of the Work, do not entitle the Contractor to any extension in the Contract Time and/or increase in Contract Sum.
  - c. ARTICLE 8.3.4: Add the following Article 8.3.4:  

All claims by the Contractor for an increase in the Contract Time must follow the procedures set forth in Articles 15.1.2 and 15.1.5, including the requirement that the Contractor give written notice of any claim within twenty-one (21) days after occurrence of the event giving rise to such claim or within twenty-one (21) days after the Contractor first recognizes the condition giving rise to the claim, whichever is earlier.
  - d. ARTICLE 8.3.5: Add the following Article 8.3.5:  

If the Contractor submits a schedule indicating or otherwise expressing an intent to complete the Work prior to the date of substantial completion, the Owner shall have no liability to the Contractor for any failure by the Contractor to complete the Work prior to the expiration of the Contract Time.

I. ARTICLE 9 - PAYMENTS AND COMPLETION

1. ARTICLE 9.3 – APPLICATION FOR PAYMENTS:

a. ARTICLE 9.3.1: Add the following sentence to the end of Article 9.3.1:

The form of Application for Payment will be the current edition of the AIA Document G702, Application and Certification for Payment, supported with AIA Document G703, Continuation Sheet.

b. ARTICLE 9.3.1.3: Add the following Article 9.3.1.3:

In any contract awarded by the state of Mississippi or any agency, unit or department of the State of Mississippi or by any political subdivision thereof, the amount of retainage that may be withheld is governed by Mississippi law.

In all other contracts, the Owner will retain, until the Work is one hundred percent (100%) complete, ten percent (10%) of the amount due the Contractor on account of progress payments. No reduction in retainage will be made until final payment is made except that when the original Contract amount is in an amount equal to or greater than \$750,000, then whenever such Work is fifty percent (50%) complete and on schedule and satisfactory, in the opinion of the Architect and the Owner, fifty percent (50%) of the retainage may be returned to the Contractor and five percent (5%) will be retained on all subsequent progress payments. The Owner may subsequently increase the retainage if the Contractor's manner of completion of the Work and/or its progress do not remain satisfactory to the Architect and/or Owner or if the Surety withholds its consent to payment for other good and sufficient reasons.

c. ARTICLE 9.3.2.1: Add the following Article 9.3.2.1:

Payment for materials stored at some location other than the Project site, may be approved by the Architect and the Owner after the Contractor has submitted the following items:

- .1 An acceptable Lease Agreement between the Contractor or one of its subcontractors or suppliers 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 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 Project.

- .6 A review by the Architect of the materials stored off-site prior to release of payment.
  - .7 Proof of payment of stored materials verified by the supplier must be submitted to the Architect within thirty (30) days of the Application for Payment on which payment for said materials was made. If proof of payment is not submitted within thirty (30) days, then payment for said materials will be deducted from the next application for payment and withheld until proof of payment is received.
2. ARTICLE 9.5 – DECISIONS TO WITHHOLD CERTIFICATION:
- a. ARTICLE 9.5.1.7: Delete the word repeated in Article 9.5.1.7.
  - b. ARTICLE 9.5.1.8: Add the following Article 9.5.1.8:  
  
The letter from the Contractor which is required by Article 15.1.5.2 has not been received.
3. ARTICLE 9.6 – PROGRESS PAYMENTS:
- a. ARTICLE 9.6.1: Delete Article 9.6.1 in its entirety and insert the following:  
  
Subject to the conditions of the Contract, the Owner shall make payment to the Contractor in the amount certified within thirty (30) days after receipt of the Certificate for Payment from the Architect. Payment shall not be considered late until thirty (30) days after Owners receipt of the approved Certificate for Payment from the Architect.
  - b. ARTICLE 9.6.1.1: In Article 9.6.1.1, Contractors Applications for Payment shall be submitted on or before the 25<sup>th</sup> day of each month. Any application not submitted on or before this date may not be processed or approved until the following month.
  - c. ARTICLE 9.6.7: Delete the word Unless from Article 9.6.7 in the first sentence and insert the phrase Whether or not.
  - d. ARTICLE 9.6.7: Add the following to the end of Article 9.6.7:  
  
The amount retained by the Contractor from each payment to each Subcontractor and material supplier shall not exceed the percentage retained by the Owner from the Contractor for the Subcontractors Work.
4. ARTICLE 9.7 – FAILURE OF PAYMENT: In the first sentence Article 9.7, delete the words "or awarded by binding dispute resolution".

## 5. ARTICLE 9.8 – SUBSTANTIAL COMPLETION:

- a. ARTICLE 9.8.1: Delete Article 9.8.1 in its entirety and insert the following:

Substantial completion for purposes of this Contract occurs only upon Contractor compliance with the following conditions precedent: (a) the Contractor furnishes to the Architect all close-out documents required by the Contract Documents in a form satisfactory to the Architect and the Owner, (b) the Contractor furnishes the manufacturers certifications and/or warranties required by the Contract Documents; (c) the Contractor furnishes the Guarantee of Work set forth herein below; and (d) the Architect certifies that the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose.

The Guarantee of Work shall be submitted as a separate document signed by Contractor and Contractors Surety and shall state the following:

Contractor and Contractors Surety hereby guarantee that all Work performed on the Project is free from defective and/or nonconforming materials and workmanship and that for a period of one year from the date of final completion or such longer period of time as may be called for in the Contract Documents for such portions of the Work, Contractor or its Surety will repair and/or replace any defective and/or nonconforming materials and workmanship in accordance with the requirements of the Contract Documents.

- b. Add the following Article 9.8.2.1:

The Contractor shall be responsible for the costs of inspections made by the Architect including any and all other related expenses incurred by the Architect for providing services for the Project required by failure of the Contractor to achieve final acceptance / completion of the Project within 30 days after the first occurrence of the below described events:

1. Specified date of Substantial Completion; or
2. Actual date of Substantial Completion.

The costs of the Architects additional services shall be deducted by the Owner from the Contractors final application for payment to pay the Architect for additional services required by the Contractors failure to achieve final completion of the project within the 30 day period described above.

- c. ARTICLE 9.8.4: Delete the last sentence of Article 9.8.4 and insert the following:

Warranties required by the Contract Documents shall commence on the date of final acceptance/ completion unless otherwise provided in the Contract Documents.

- d. ARTICLE 9.8.5: Add the following to the end of Article 9.8.5:

Contractors execution of the Certificate of Substantial Completion constitutes Contractors representation that the items on the list accompanying the Certificate can and will be completed by Contractor and his subcontractors within thirty (30) days of Contractors execution of the Certificate. Based upon this representation by Contractor and upon the acknowledgment of the Architect that the listed items remaining can be completed within thirty (30) days, the Owner agrees to execute the Certificate of Substantial Completion. If Contractor fails to complete the items on the list within thirty (30) days of Contractors execution of the Certificate, then the Owner, at its option and without prejudice to any other rights or remedies it may have under this Contract or otherwise and without notice to Contractor or Surety, may proceed to have same completed and to deduct the reasonable costs thereof from the amounts then due or thereafter to become due to Contractor.

- e. ARTICLE 9.8.6: Add the following Article 9.8.6:

The costs of inspections requested by Contractor and made by Architect which are not required by Articles 4, 9.8 or 9.10 or 12 of the General Conditions and any other inspection required by Article 12 other than the year-end inspection itself, will be the responsibility of the Contractor and will be deducted by the Owner from the Application for Payment submitted after the Owners receipt of the Architects statement for its costs of additional inspections. These costs are not the result of Contractors failure to timely complete the Contract within the specified time and, therefore, such costs are in addition to and not a part of any liquidated damages calculation, if any.

- f. ARTICLE 9.8.7: Add the following Article 9.8.7:

Upon the Owners acceptance of the Work as substantially complete and upon Contractors compliance with all conditions precedent to substantial completion as stated in Section 00800, Article 9.8.1 and upon application by the Contractor, the Owner will pay to the Contractor all retainage held by the Owner less an amount equal to the greater of (a) two percent (2%) of the Contract Sum, or (b) two hundred percent (200%) of the estimated cost of the Work remaining to be performed by the Contractor in accordance with the Architects determination. Final payment, including all retainage, shall be made at the time and in the manner provided for final payment in accordance with the provisions of Article 9.10 and the additional conditions precedent to final acceptance / payment set forth in Section 00800, Article 9.8.5.

6. ARTICLE 9.9.1.2 – PARTIAL OCCUPANCY OR USE: Add the following Article 9.9.1.2:

The Owners occupancy or use of any completed or partially completed portions of the Work shall not affect Contractors obligation to complete incomplete items on the list attached to the Certificate of Substantial Completion within the time fixed in the Certificate and does not waive Owners right to obtain completion of incomplete items at Contractors expense upon Contractors failure to timely complete same.

7. ARTICLE 9.11 – LIQUIDATED DAMAGES:

Liquidated Damages. Time being of the essence of this Contract 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 pay the Owner the sums hereinafter stipulated as fixed and agreed as liquidated damages for each calendar day for delay until the Work is substantially complete. The Contractor and his Surety acknowledge that the Owner's losses caused by the Contractor's delay are not readily ascertainable and that the amount estimated per day for liquidated damages is reasonable and is not a penalty.

NOTE: The amount established per day for liquidated damages is \$500.00.

- J. ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY:

1. ARTICLE 10.1 – SAFETY PRECAUTIONS AND PROGRAMS: Add the following to the end of Article 10.1:

The Architect shall not administer the Contractors performance of its duties and responsibilities under Article 10 (including Articles 10.1 through 10.6) because the initiation, maintenance and supervision of safety precautions and programs is the sole responsibility of the Contractor as means, methods, techniques, sequences and procedures of construction and, therefore, is not part of the Contractors scope of Work which is to be administered by the Architect.

- K. ARTICLE 11 – INSURANCE AND BONDS:

1. ARTICLE 11.1 – CONTRACTOR'S LIABILITY INSURANCE:

a. ARTICLE 11.1.1.5: Delete in Article 11.1.1.5 the words "other than the Work itself".

b. ARTICLE 11.1.1.9: Add the following Article 11.1.1.9:

Liability insurance will include all major divisions of coverage and be on a comprehensive basis including:

1. Premises - operations.
2. Independent Contractor's Protective.



- 3. Products and completed operations.
- 4. Contractual Liability- including specified provisions for the Contractor's obligations under 3.18.
- 5. Personal Injury Liability
- 6. Owned, non-owned and hired motor vehicles.
- 7. Broad form coverage for property damage.
- 8. Owner and Architect will be listed as additional insured on policy.
- 9. Owner and Architect are to be provided with a waiver of subrogation on all policies.

c. ARTICLE 11.1.2: Delete Article 11.1.2 in its entirety and insert the following:

The insurance required by Article 11.1.1 will be written for not less than the following, or greater amounts if required by law or if deemed necessary by the Contractor to protect its interests.

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

General Aggregate	\$2,000,000	Aggregate
Products & Completed Operations	\$2,000,000	Aggregate
Personal & Advertising Injury	\$1,000,000	Per Occurrence
Bodily Injury & Property Damage	\$1,000,000	Per Occurrence
Fire Damage Liability	\$500,000	Per Occurrence
Medical Expense	\$5,000	Per Person
- .2 AUTOMOBILE LIABILITY:  
(Owned, non-owned & hired vehicles)  
Contractor Insurance Option Number 1:
 

Bodily Injury & Property Damage	\$1,000,000	Per Occurrence
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 (Combined Single Limit)
- .3 EXCESS LIABILITY:  
(Umbrella on projects over \$500,000)
 

Bodily Injury & Property Damage	\$1,000,000	Aggregate
(Combined Single Limit)	\$1,000,000	Per Occurrence
- .4 WORKERS' COMPENSATION:  
(As required by Statute)  
EMPLOYERS' LIABILITY
 

Accident	\$1,000,000	Per Occurrence
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- .5 PROPERTY INSURANCE:  
Builder's Risk
 

	\$ Value of the Work	
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d. ARTICLE 11.1.3: Add in Article 11.1.3 the following after the second sentence:

The Owner and Architect will be named as additional insured's on the Contractors CGL policy and the Contractors certificate of insurance must state that the Owner and Architect are additional insured's under the referenced CGL policy and that all of Contractors contractual liabilities, including but not limited to its indemnity obligations, are covered by such CGL policy.

Any language contained on the certificate of insurance form or elsewhere to the contrary is deemed stricken.

The certificate of insurance must also state that all of Contractors contractual liabilities, including but not limited to its indemnity obligations, are covered. Any terms and conditions contained in the certificate of insurance which are contrary to the Contractors contractual obligations are hereby stricken from the certificate.

- e. ARTICLE 11.1.5: Add the following Article 11.1.5:

Furnish one copy of the certificate herein required for each copy of the Agreement, specifically setting forth evidence of all coverage required by Article 11. The form of the certificate will be AIA Document G715 or a similar form acceptable to Owner. Furnish to the Owner and Architect, copies of any endorsements that are subsequently issued amending coverage or limits. If the coverages are provided on a claims-made basis, the policy date or retroactive date shall predate the Contract and the termination date of the policy, or the applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment.

2. ARTICLE 11.2 – OWNER’S LIABILITY INSURANCE: Delete Article 11.2 in its entirety and insert the following:

The Contractor will pay for and maintain such insurance as will protect the Owner and Architect from their contingent liability to others for damages because of bodily injury, including death, 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 shall be filed with the Owner and Architect and will be the same limits set forth in Article 11.1.2.

3. ARTICLE 11.3 PROPERTY INSURANCE:

- 1) ARTICLE 11.3.1: Delete in Article 11.3.1 the phrase Unless otherwise provided, the Owner from the first line and insert the phrase "The Contractor".
- 2) ARTICLE 11.3.2: Delete Article 11.3.1.2 in its entirety and insert the following:  
If the Contractor fails to purchase and maintain such insurance and the Owner is damaged by such failure, then the Contractor shall be liable to the Owner for all such damages incurred by the Owner.
- 3) ARTICLE 11.3.3: Delete Article 11.3.1.3 in its entirety and insert the following:  
If the property insurance requires minimum deductibles, the Contractor shall pay the deductible and all other costs not covered because of such deductibles. If the Contractor or insurer increases the required minimum deductibles above the amounts so identified or if the Contractor elects to purchase this insurance with voluntary deductible amounts, the Contractor shall be responsible for payment of the additional costs not covered because of such increased or voluntary deductibles.

- 4) ARTICLE 11.3.2: Delete Article 11.3.2 in its entirety.
- 5) ARTICLE 11.3.3: Delete Article 11.3.3 in its entirety.
- 6) ARTICLE 11.3.4: Delete Article 11.3.4 in its entirety.
- 7) ARTICLE 11.3.5: Delete Article 11.3.5 in its entirety.
- 8) ARTICLE 11.3.6: Delete Article 11.3.6 in its entirety.
- 9) ARTICLE 11.3.10: Delete Article 11.3.10 in its entirety and insert the following:  
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) business days after occurrence of loss.
- 10) ARTICLE 11.3.11: Add the following Article 11.3.11:  
In addition to the above, the Contractor shall obtain in the Owners and Architects names, and maintain during the same time period, Public Protective Liability Insurance and Property Damage Insurance in the amount of not less than \$1,000,000 combined single limit, which policies shall cover the operations of the Contractor, and those of his subcontractors to protect the Owner and Architect from loss. This protection is not to be considered as a separate policy by the Contractor, but shall be a rider to the Contractors coverage.

**L. ARTICLE 12.2 – CORRECTION OF WORK:**

**1. ARTICLE 12.2.2 – AFTER SUBSTANTIAL COMPLETION:**

- a. ARTICLE 12.2.2.1: Add the following to the end of Article 12.2.2.1:  
Prior to the end of the one-year period, the Architect may schedule a warranty inspection which shall be attended by the Architect, the Owner, the Contractor and all major subcontractors. During this inspection, the parties shall identify all defective and/or nonconforming items and fix a time within which all defective and/or nonconforming items shall be repaired and/or replaced.
- b. ARTICLE 12.2.2.1.1: Add the following Article 12.2.2.1.1:  
Within the one-year period provided for in the Guarantee of Work required by Article 9.8.1, if repairs or replacement are requested by Owner in connection with the 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 Contract Documents, the Contractor and/or its Surety shall promptly, upon receipt of notice from and without expense to the Owner, place in satisfactory condition in every particular, all such Work, correct all defects therein and make good all damages to the building, site, equipment or contents thereof; and make good any work or materials or the equipment and contents of said buildings or site disturbed in fulfilling any such guarantee. If, after notice or within the time agreed upon by the parties at the warranty inspection, the Contractor and/or its Surety fail to proceed promptly to

comply with the terms of the guarantee, the Owner may have the defects corrected in accordance with Article 2.4 and the Contractor and his Surety shall be liable for all expenses incurred. All special guarantees applicable to definite parts of the Work stipulated in the Contract Documents shall be subject to the terms of this paragraph during the first year of the life of such special guarantee.

M. ARTICLE 13 - MISCELLANEOUS PROVISIONS:

1. ARTICLE 13.6 – INTEREST: Delete Article 13.6 in its entirety and insert the following:  
Payments due and unpaid under the Contract Documents shall bear interest as provided by applicable Mississippi law.
2. ARTICLE 13.7: Delete in Article 13.7 the phrase in accordance with the requirements of the final dispute resolution method selected within the Agreement.
3. ARTICLE 13.8 – ATTORNEYS FEES AND EXPENSES: Add the following Article 13.8 to private projects not funded in whole or in part by public monies.

The prevailing party in any dispute between the parties arising out of or related to this Agreement or the breach thereof, shall be entitled to reasonable attorneys and expert witness(es) fees and expenses incurred in pursuing or defending any claim.

N. ARTICLE 14 – TERMINATION OR SUSPENSION OF THE CONTRACT:

1. ARTICLE 14.1 – TERMINATION BY THE CONTRACTOR:
  - a. ARTICLE 14.1.1.4: Delete Article 14.1.1.4 in its entirety.
2. ARTICLE 14.2 – TERMINATION BY THE OWNER FOR CAUSE:
  - a. ARTICLE 14.2.1.1: Delete the word repeatedly from Article 14.2.1.1.
  - b. ARTICLE 14.2.1.3: Delete the word repeatedly from Article 14.2.1.3.
  - c. ARTICLE 14.2.1.5 AND 14.2.1.6: Add the following Articles 14.2.1.5 and 14.2.1.6:
    - .5 fails to achieve Substantial Completion of the Project as described in Section 008000, Article 9.8.5, within the time stated therein;
    - .6 fails to meet any deadline required by the Contract. Contractor acknowledges that time is of the essence of this Contract and that all deadlines required by the Contract are critical to timely completion of the Contract. Therefore, Contractor agrees that its failure to meet any deadline constitutes a substantial and material breach of this Contract, entitling the Owner to terminate the Contract.
  - d. ARTICLE 14.2.2: Delete in Article 14.2.2 the word certification in the first sentence and insert the word advice and delete the phrase Initial Decision Maker and insert the word Architect.

- e. ARTICLE 14.2.4: Delete in Article 14.2.4 the phrase Initial Decision Maker and insert the word Architect.
  - f. ARTICLE 14.2.5: Add the following Article 14.2.5:

If the Owner terminates the Contract for cause, and it is determined for any reason that the Contractor was not actually in default under the Contract at the time of termination, the Contractor shall be entitled to recover from the Owner the same amount as the Contractor would be entitled to receive under a termination for convenience as provided by Article 14.4. The foregoing shall constitute the Contractors sole and exclusive remedy for termination of the Contract. In no event shall the Contractor be entitled to special, consequential, or exemplary damages, nor shall the Contractor be entitled to anticipated profits resulting from termination of this Contract.
  3. ARTICLE 14.4.3 – TERMINATION BY THE OWNER FOR CONVENIENCE: Delete from the last line of Article 14.4.3 the phrase along with reasonable overhead and profit on the Work not executed and add after the end of that sentence: The Contractor shall not be entitled to receive any payment for either overhead or profit on work not performed.
- O. ARTICLE 15 - CLAIMS AND DISPUTES
1. ARTICLE 15.1.5 – CLAIMS FOR ADDITIONAL TIME: Delete Article 15.1.5 in its entirety.
  2. ARTICLE 15.2.4 – INITIAL DECISION: Add within thirty (30) days to the end of Article 15.2.4.
  3. ARTICLE 15.3 – MEDIATION:
    - a. ARTICLE 15.3.1: Delete in Article 15.3.1 the phrase shall be subject to mediation as a condition precedent to binding dispute resolution and insert the phrase may be subject to mediation upon mutual agreement of the Owner and Contractor.
    - b. ARTICLE 15.3.2: Delete in Article 15.3.2 the word shall in the first sentence wherever it appears and insert the word may.
  4. ARTICLE 15.4 – ARBITRATION:
    - a. ARTICLE 15.4.1: Delete in Article 15.4.1 the word parties in the first sentence and insert the word Owner and delete the phrase unless the parties mutually agree in the first sentence and insert the phrase unless the Owner chooses.
    - b. ARTICLE 15.4.4 – CONSOLIDATION OR JOINDER:
      - 1) ARTICLE 15.4.4: Delete Article 15.4.4 in its entirety and insert the following:

- 2) ARTICLE 15.4.4.1: In Article 15.4.4.1, the Owner, at its sole discretion, may consolidate any arbitration, if any, conducted under this Agreement with any other arbitration to which it is a party where the Owner determines that the arbitrations to be consolidated substantially involve common questions of law or fact and the Owner, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 008000

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 PROJECT INFORMATION

- A. Project Identification: Fine Arts Building Renovation
  - 1. Project Location: Fulton, Mississippi
- B. Owner: Itawamba Community College
- C. Architect: McCarty Architects, P.A., Tupelo, MS.
- D. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
  - 1. Corbett Legge and Associates, LLC, Tupelo, MS.
- E. This project consists of interior renovations of the existing Fine Arts Building on the Fulton campus of Itawamba Community College. Area of work is approximately 16,700 sq ft. Primarily replacement of interior finishes, the project also includes electrical, plumbing and HVAC upgrades, audio/video equipment and performance lighting.

1.2 WORK RESTRICTIONS

- A. Contractor's Use of Premises: During construction, Contractor will have full use of area indicated. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project.
  - 1. Owner will occupy premises during construction. Perform construction between 7 AM to 5 PM Monday thru Friday, other than holidays, unless otherwise agreed to in advance by Owner. Clean up work areas and return to usable condition at the end of each work period.
  - 2. Limits: Limit building disturbance, to the area indicated on project drawings.
- B. Nonsmoking Campus: Smoking is not permitted on the ICC Campus.

END OF SECTION 011000





**SECTION 012100 - ALLOWANCES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
  - 1. Lump-sum allowances.
- C. Related Requirements:
  - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
  - 2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

**1.3 DEFINITIONS**

- A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

**1.4 SELECTION AND PURCHASE**

- A. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

**1.5 ACTION SUBMITALS**

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

**1.7 LUMP-SUM ALLOWANCES**

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
  - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

**1.8 ADJUSTMENT OF ALLOWANCES**

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
  - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
  - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
  - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
  - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

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

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

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

**3.2 PREPARATION**

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

**3.3 SCHEDULE OF ALLOWANCES**

- A. Allowance No. 1: Lump Sum Allowance of \$50,000 (Fifty Thousand Dollars) to be used at the Owner's discretion for cost associated with unknown latent conditions as found during the construction process.
- B. Allowance No. 2: Lump Sum Allowance of \$325,000.00 (Three Hundred Twenty-five Thousand Dollars) to be included in the Electrical Contractor's bid to procure the Theatrical Lighting Systems described herein and further illustrated on Division 26 drawings.
- C. Allowance No. 3: Lump Sum Allowance of \$140,000.00 (One Hundred Forty Thousand Dollars) to be included in the Electrical Contractor's bid to procure the Audio Visual Systems described herein and further illustrated on Division 26 drawings.

**END OF SECTION 012100**



**SECTION 012600 - CONTRACT MODIFICATION PROCEDURES**

**PART 1 - GENERAL**

**1.1 CONTRACT MODIFICATION PROCEDURES**

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."
- B. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work.
  - 1. Proposal Requests are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within fifteen (15) days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time.
- C. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
- D. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701, for all changes to the Contract Sum or the Contract Time.
- E. Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- F. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

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

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 012600**



**SECTION 012900 - PAYMENT PROCEDURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of Contractor's construction schedule.

**1.3 DEFINITIONS**

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

**1.4 SCHEDULE OF VALUES**

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
  - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than fourteen days before the date scheduled for submittal of initial Applications for Payment.
  - 3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  2. Arrange schedule of values consistent with format of AIA Document G703.
  3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
  7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
  8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.



**1.5 APPLICATIONS FOR PAYMENT**

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
  - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  - 3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three (3) signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. All copies shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Products list (preliminary if not final).
  5. Submittal schedule (preliminary if not final).
  6. List of Contractor's principal consultants.
  7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  8. Initial progress report.
  9. Report of preconstruction conference.
  10. Certificates of insurance and insurance policies.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900



**SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Requests for Information (RFIs).
  - 3. Project meetings.
- B. Related Requirements:
  - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

**1.3 DEFINITIONS**

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Supervisor: Prepare a written summary identifying individuals or firms proposed to coordinate the efforts of all the entities under contract to facilitate the demolition and new construction work in a timely and orderly manner. Include the following information in tabular form:
  - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including all personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

#### 1.5 GENERAL COORDINATION PROCEDURES

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

**1.6 REQUESTS FOR INFORMATION (RFIs)**

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01250 "Contract Modification Procedures."
  - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

## 1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.



2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.
    - f. Procedures for processing field decisions and Change Orders.
    - g. Procedures for RFIs.
    - h. Procedures for processing Applications for Payment.
    - i. Distribution of the Contract Documents.
    - j. Submittal procedures.
    - k. Preparation of record documents.
    - l. Use of the premises and existing building.
    - m. Work restrictions.
    - n. Working hours.
    - o. Owner's occupancy requirements.
    - p. Responsibility for temporary facilities and controls.
    - q. Procedures for moisture and mold control.
    - r. Parking availability.
    - s. Office, work, and storage areas.
    - t. Equipment deliveries and priorities.
    - u. First aid.
    - v. Security.
    - w. Progress cleaning.
  4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.

- d. Preparation of Contractor's punch list.
  - e. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
  - f. Submittal procedures.
  - g. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- D. Progress Meetings: Conduct progress meetings at biweekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Progress cleaning.
      - 10) Quality and work standards.
      - 11) Status of correction of deficient items.
      - 12) Field observations.
      - 13) Status of RFIs.
      - 14) Status of proposal requests.
      - 15) Pending changes.
      - 16) Status of Change Orders.
      - 17) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
  - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- E. Coordination Meetings: Conduct Project coordination meetings at biweekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each contractor present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Work hours.
      - 10) Hazards and risks.
      - 11) Progress cleaning.
      - 12) Quality and work standards.
      - 13) Change Orders.
  3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

**SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

- 1. Startup construction schedule.
- 2. Contractor's construction schedule.
- 3. Construction schedule updating reports.
- 4. Daily construction reports.
- 5. Material location reports.
- 6. Site condition reports.
- 7. Special reports.

- B. Related Requirements:

- 1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
- 2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

**1.3 DEFINITIONS**

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

- 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
- 2. Predecessor Activity: An activity that precedes another activity in the network.
- 3. Successor Activity: An activity that follows another activity in the network.

- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- D. Event: The starting or ending point of an activity.

- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. PDF electronic file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
  - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Submit at weekly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Special Reports: Submit at time of unusual event.

#### 1.5 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from entities involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

**PART 2 - PRODUCTS**

**2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL**

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01330 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  - 4. Punch List and Final Completion: Include not more than 10 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  - 1. Phasing: Arrange list of activities on schedule by phase.
  - 2. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Use of premises restrictions.
    - e. Provisions for future construction.
    - f. Seasonal variations.
    - g. Environmental control.
  - 3. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Temporary enclosure and space conditioning.
    - c. Permanent space enclosure.
    - d. Final Completion.

- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:
1. Temporary enclosure.
  2. Permanent enclosure.
  3. Final Completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
  2. Unanswered Requests for Information.
  3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and Contract Time.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

## 2.2 STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

## 2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.



B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

## 2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions, including presence of rain or snow.
6. Accidents.
7. Meetings and significant decisions.
8. Unusual events (see special reports).
9. Stoppages, delays, shortages, and losses.
10. Emergency procedures.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Work Change Directives received and implemented.
14. Services connected and disconnected.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

**PART 3 - EXECUTION**

**3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE**

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate final completion percentage for each activity.
  
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

**SECTION 013300 - SUBMITTAL PROCEDURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

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

**1.3 DEFINITIONS**

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

**ACTION SUBMITTALS**

- D. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

- a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
- 4. Format: Arrange the following information in a tabular format:
  - a. Scheduled date for first submittal.
  - b. Specification Section number and title.
  - c. Submittal category: Action; informational.
  - d. Name of subcontractor.
  - e. Description of the Work covered.
  - f. Scheduled date for Architect's final release or approval.
  - g. Scheduled date of fabrication.
  - h. Scheduled dates for purchasing.
  - i. Scheduled dates for installation.
  - j. Activity or event number.

**1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS**

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - 1. Initial Review: Allow 10 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.
  - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  - 3. Resubmittal Review: Allow 10 days for review of each resubmittal.
  - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 10 days for initial review of each submittal.

## D. Electronic Submittal Procedures

## 1. Summary:

- a. Shop drawing and product data submittals shall be transmitted to Architect in electronic (PDF) format using McCarty's FTP, or other web-based submittal management systems (ie, Procore, Submittal Exchanges, etc.), as provided by the Contractor. Emailing of submittals will not be considered.
- b. The electronic submittal process is not intended for color samples, color charts, or physical material samples.

## 2. Procedures:

- a. Submittal Preparation - Contractor may use any or all of the following options:
  - 1) Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the FTP website, or other web-based means.
  - 2) Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format.
  - 3) Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
- 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. All files should be placed in the corresponding section folder of the division folder located on the project FTP site as follows:  
  
<https://ftp.mccartycompany.com/.../Division 03/033000>
- d. Notification:
  - 1) General Contractor shall notify the architect and the architect's project administrator via email of uploaded submittals on the project FTP site.
  - 2) The submittal notification shall include a specific list of all new submittals uploaded to the project FTP site along with a description of the submittals.
  - 3) A timeframe for review of each submittal requested by the General Contractor shall be included within the submittal notification.
- e. File Naming:
  - 1) All file names should begin with the specification section, followed by a two digit submittal number with a submission letter and ending with the submitted date of the file as follows:  
033000-01-A\_03DEC19.pdf
  - 2) If submittals are being *resubmitted* due to an unaccepted initial review, the new submittal file name should begin with the specification section, followed by the original two digit submittal number with a new

sequential letter and ending with the new submitted date of the file as follows:

033000-01-B\_12JAN19.pdf

- f. Upon notification, Architect / Engineer will download documents from the FTP site. Review comments will be uploaded back to FTP site. Contractor will receive email notice of completed review. Review files will be named to include "Returned" as follows:

033000-01-A\_12JAN17\_RETURNED\_18DEC19.pdf

- g. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.

3. Costs:

- a. Internet Service and Equipment Requirements:

- 1) Email address and Internet access at Contractor's main office.
- 2) Adobe Acrobat ([www.adobe.com](http://www.adobe.com)), Bluebeam PDF Revu ([www.bluebeam.com](http://www.bluebeam.com)), or other similar PDF review software for applying electronic stamps and comments.

- E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

**PART 2 - PRODUCTS**

**2.1 SUBMITTAL PROCEDURES**

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
  
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before or concurrent with Samples.
  - 6. Submit Product Data in the following format:
    - a. PDF electronic file.

- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
  3. Submit Shop Drawings in the following format:
    - a. PDF electronic file.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
    - e. Specification paragraph number and generic name of each item.
  3. For projects where electronic submittals are required, provide corresponding electronic submittal of sample transmittal, digital image file illustrating sample characteristics and identification information to be included as part of Record Documents.
  4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples not designated as Owner's property are the property of Contractor.
- E. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012000 "Payment Procedures."
- F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."



- G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017000 "Closeout Procedures."
- H. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- I. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- K. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- O. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- P. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- Q. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- R. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- S. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads.

Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

## 2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### 3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300



## SECTION 014000 - QUALITY REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SECTION REQUIREMENTS

- A. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
- B. The Owner will employ third party testing for verification of soils after excavation, backfilling and compaction for compliance with requirements of ASTM D 698.
- C. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Architect for a decision.
- D. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum. The actual installation may exceed the minimum within reasonable limits. Indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision.
- E. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- F. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and re-inspecting.

- G. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, notices, receipts for fee payments, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- H. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.
- I. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated; and where required by authorities having jurisdiction, that is acceptable to authorities.
- J. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- K. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Architect and Contractor of irregularities or deficiencies in the Work observed during performance of its services.
  - 2. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
  - 3. Do not perform any duties of Contractor.
- L. Associated Services: Cooperate with testing agencies and provide reasonable auxiliary services as requested. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  - 4. Facilities for storage and field curing of test samples.
  - 5. Security and protection for samples and for testing and inspecting equipment.
- M. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

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

**PART 3 - EXECUTION**

**3.1 REPAIR AND PROTECTION**

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
- B. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

**END OF SECTION 014000**





SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Abbreviations and Acronyms: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

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

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

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

CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association (Electrostatic Discharge Association)
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA)
FM Approvals	FM Approvals LLC
FM Global	FM Global (Formerly: FMG - FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Part of GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydronics Institute
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI)
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)

HPVA	Hardwood Plywood & Veneer Association
IAPSC	International Association of Professional Security Consultants
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers Association, Inc.
ICPA	International Cast Polymer Association
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISA	Instrumentation, Systems, and Automation Society, The
ISO	International Organization for Standardization Available from ANSI
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA (Now ETL SEMCO)
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LGSEA	Light Gauge Steel Engineers Association
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MCA	Metal Construction Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling

(Now MHIA)

MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCMA	National Concrete Masonry Association
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)

NOMMA	National Ornamental & Miscellaneous Metals Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
PCI	Precast/Prestressed Concrete Institute
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SCAQMD	South Coast Air Quality Management District
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SIA	Security Industry Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association

SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
TCNA	Tile Council of North America, Inc.
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)



WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

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

DIN	Deutsches Institute fur Normung e.V.
IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.
DIN	Deutsches Institute fur Normung e.V.
IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200



**SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS**

**PART 1 - GENERAL**

**1.1 SECTION REQUIREMENTS**

- A. Use Charges: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated.
- B. Water and Electric Power: Available from Owner's existing system without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- D. Accessible Temporary Egress: Comply with applicable provisions in ICC A117.1.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts and top and bottom rails. See project boundary in drawings for routing of temporary fencing.

**2.2 TEMPORARY FACILITIES**

- A. Field office may be set up within existing building. Store combustible materials apart from building.

**2.3 EQUIPMENT**

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

**2.4 PROJECT SIGNAGE**

- A. Provide project signage of vinyl applied on sheet metal attached to wood frame at exterior of building at location to be determined by the Owner. Signage will be 4 feet wide by 6 feet high, one-sided. Sample signage graphic is attached. Architect will provide final project-specific graphic after Contract Award.

**PART 3 - EXECUTION**

**3.1 TEMPORARY UTILITY INSTALLATION**

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
- C. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

**3.2 SUPPORT FACILITIES INSTALLATION**

- A. Install project identification and other signs in locations approved by Owner to inform the public and persons seeking entrance to Project.
- B. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

**3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION**

- A. Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- E. Furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

- F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- G. Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- H. Install and maintain temporary fire-protection facilities. Comply with NFPA 241.

**3.4 MOISTURE AND MOLD CONTROL**

- A. Before installation of weather barriers, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.
  - 1. Protect stored and installed material from flowing or standing water.
  - 2. Remove standing water from decks.
  - 3. Keep deck openings covered or dammed.
- B. After installation of weather barriers but before full enclosure and conditioning of building, protect as follows:
  - 1. Do not load or install drywall or porous materials into partially enclosed building.
  - 2. Discard water-damaged material.
  - 3. Do not install material that is wet.
  - 4. Discard, replace, or clean stored or installed material that begins to grow mold.
  - 5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

**3.5 OPERATION, TERMINATION, AND REMOVAL**

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion.
- C. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period.

END OF SECTION 015000



**SECTION 016000 - PRODUCT REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION REQUIREMENTS**

- A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.
  - 1. Show compliance with requirements for comparable product requests.
  - 2. Architect will review the proposed product and notify Contractor of its acceptance or rejection.
- C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.
- D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.
- E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
  - 4. Store materials in a manner that will not endanger Project structure.
  - 5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
- F. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

**PART 2 - PRODUCTS**

**2.1 PRODUCT SELECTION PROCEDURES**

- A. Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at the time of installation.
  - 1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.

2. Where products are accompanied by the term "as selected," Architect will make selection.
  3. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Where the following headings are used to list products or manufacturers, the Contractor's options for product selection are as follows:
1. Products:
    - a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
    - b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.
  2. Manufacturers:
    - a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.
    - b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.
  3. Basis-of-Design Product: Provide the product named, or indicated on the Drawings, or a comparable product by one of the listed manufacturers.
- C. Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- D. Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Architect will consider Contractor's request for comparable product when the following conditions are satisfied:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those named in the Specifications.
  3. List of similar installations for completed projects, if requested.
  4. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000



**SECTION 017300 - EXECUTION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

- 1. Construction layout.
- 2. Field engineering and surveying.
- 3. Installation of the Work.
- 4. Cutting and patching.
- 5. Coordination of Owner-installed products.
- 6. Progress cleaning.
- 7. Starting and adjusting.
- 8. Protection of installed construction.
- 9. Correction of the Work.

- B. Related Requirements:

- 1. Section 011000 "Summary" for limits on use of Project site.
- 2. Section 013300 "Submittal Procedures" for submitting surveys.
- 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

**1.3 DEFINITIONS**

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
  2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
  3. Products: List products to be used for patching and firms or entities that will perform patching work.
  4. Dates: Indicate when cutting and patching will be performed.
  5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
    - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

## 1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
    - a. Primary operational systems and equipment.
    - b. Fire separation assemblies.
    - c. Air or smoke barriers.
    - d. Fire-suppression systems.
    - e. Mechanical systems piping and ducts.
    - f. Control systems.
    - g. Communication systems.
    - h. Fire-detection and -alarm systems.
    - i. Conveying systems.

- j. Electrical wiring systems.
  - k. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
- a. Water, moisture, or vapor barriers.
  - b. Membranes and flashings.
  - c. Exterior curtain-wall construction.
  - d. Sprayed fire-resistive material.
  - e. Equipment supports.
  - f. Piping, ductwork, vessels, and equipment.
  - g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

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

**PART 3 - EXECUTION****3.1 EXAMINATION**

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

**3.2 PREPARATION**

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

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish limits on use of Project site.
  - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 4. Inform installers of lines and levels to which they must comply.
  - 5. Check the location, level and plumb, of every major element as the Work progresses.
  - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.

- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.



**3.7 OWNER-INSTALLED PRODUCTS**

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
  - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
  - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

**3.8 PROGRESS CLEANING**

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

### 3.10 PROTECTION OF INSTALLED CONSTRUCTION

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

END OF SECTION 017300

**SECTION 017700 - CLOSEOUT PROCEDURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
  - 5. Repair of the Work.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for progress cleaning of Project site.
  - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 4. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

**1.4 CLOSEOUT SUBMITTALS**

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

**1.6 SUBSTANTIAL COMPLETION PROCEDURES**

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
  - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."

6. Advise Owner of changeover in heat and other utilities.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements, including touchup painting.
  10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. **The Architect will make one inspection of the project to make the final punch list. The Contractor knows just as well as the Architect when the project is ready for final inspection.**
  2. It is the Contractor's responsibility to determine when he is ready for the final inspection and to schedule that inspection with the Owner and Architect with at least 7 days notice. If the Architect arrives at the job site for the scheduled final inspection and determines that punch list items are excessive and terminates the inspection, Contractor must reimburse the Architect for the cost of the terminated inspection trip. Architect will charge the Contractor based on his normal hourly billing rates and expense reimbursement schedule. Contractor must reimburse the Architect in a like manner each time an inspection trip is terminated for excessive punch list items. Owner reserves the right to deduct this amount, if any, from the Contractors Final Application for Payment and reimburse Architect.
  3. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  4. Results of completed inspection will form the basis of requirements for final completion.

#### 1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

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

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
  - a. Project name.
  - b. Date.
  - c. Name of Architect.
  - d. Name of Contractor.
  - e. Page number.
4. Submit list of incomplete items in the following format:
  - a. PDF electronic file. Architect, will return annotated file.

#### 1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
  1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## **PART 3 - EXECUTION**

### **3.1 FINAL CLEANING**

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in a hospital cleaning and maintenance program. Comply with manufacturer's written instructions.
  1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.

- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - h. Sweep concrete floors broom clean in unoccupied spaces.
  - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - o. Clean ducts, blowers, and coils of HVAC units.
    - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
  - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - q. Leave Project clean and ready for occupancy.
2. Complete the following cleaning operations per CHS standards for interior areas:
- a. High Dust      High Dust all ceiling tiles, vents, walls and horizontal ledges with dust control tool. Dust mopping to include corners, baseboards, and hard-to-reach areas.
  - b. Walls and Windows      Wash completely interior wall surface and windows. Hang clean curtains if needed.
  - c. Baseboards      Clean baseboards of dust.
  - d. Clean Bathroom Fittings      Thoroughly clean and disinfect hand basins, baths, commodes, seat (both sides), towel and paper fittings, mirrors, and sinks. Scrub shower cabinet floors and wipe clean shower walls and curtains. Cleaning will include inside and outside of basins, baths, and toilets and damp dusting of pipes.
  - e. Damp Dust      Damp dust with germicidal solution.
  - f. Dust Mop      Dust mop all corners, edges and floor.
  - g. Wet Mop      Wet mop all hard-surfaced floors with approved detergent and then germicidal solution.
  - h. Spray Buff      If needed, spray buff floor.



- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

**3.2 REPAIR OF THE WORK**

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

END OF SECTION 017700



**SECTION 017823 - OPERATION AND MAINTENANCE DATA**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, subsystems, and equipment.
  - 4. Product maintenance manuals.
  - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
  - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

**1.3 DEFINITIONS**

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

**1.4 CLOSEOUT SUBMITTALS**

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operations and maintenance manuals in the following format:
  - 1. Searchable PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
    - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

**PART 2 - PRODUCTS**

**2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY**

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

**2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Name and contact information for Construction Manager.
  - 7. Name and contact information for Architect.
  - 8. Name and contact information for Commissioning Authority.
  - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic searchable PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

## 2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
  1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
  1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

## 2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has delegated design responsibility.
  3. Operating standards.

4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

**B. Descriptions: Include the following:**

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

**C. Operating Procedures: Include the following, as applicable:**

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

**D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.**

**E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.**

**2.5 PRODUCT MAINTENANCE MANUALS**

**A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.**

**B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.**

- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
  
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
  
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
  
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

**2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS**

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
  
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
  
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.



- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
  
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
  
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
  
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
  
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

**PART 3 - EXECUTION**

**3.1 MANUAL PREPARATION**

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
  
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
  
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
  
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original project record documents as part of operation and maintenance manuals.
  - 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
  
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

**SECTION 017839 - PROJECT RECORD DOCUMENTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for final property survey.
  - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
  - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

**1.3 CLOSEOUT SUBMITTALS**

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set(s) of marked-up record prints. (full size)
  - 2. Number of Copies: Submit copies of record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit searchable PDF electronic files of scanned record prints and one of file prints.
      - 2) Submit record digital data files and one set(s) of plots.
      - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit searchable PDF electronic files of scanned record prints and one set of prints.
      - 2) Print each drawing, whether or not changes and additional information were recorded.

- B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated searchable PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated searchable PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

## PART 2 - PRODUCTS

### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding archive photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations below first floor.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.

- k. Changes made following Architect's written orders.
  - l. Details not on the original Contract Drawings.
  - m. Field records for variable and concealed conditions.
  - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Coordinate requirements in "Record Digital Data Files" Paragraph below with general requirements for use and submission of digital data files in Section 013300 "Submittal Procedures."
- C. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated searchable PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
- D. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
  2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- E. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated searchable PDF electronic file with comment function enabled.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

4. Identification: As follows:
  - a. Project name.
  - b. Date.
  - c. Designation "PROJECT RECORD DRAWINGS."
  - d. Name of Architect.
  - e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
  5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated searchable PDF electronic file.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated searchable PDF electronic file.
  1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

## 2.4 FINISH LEGEND

- A. Provide final finish legend showing each specific product used with color, texture, and finish. Coordinate final finish legend with final asbuilt floor plan. Provide in PDF format.

**2.5 MISCELLANEOUS RECORD SUBMITTALS**

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as searchable PDF electronic file.
  - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

**PART 3 - EXECUTION**

**3.1 RECORDING AND MAINTENANCE**

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

END OF SECTION 017839





**SECTION 017900 - DEMONSTRATION AND TRAINING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

**1.4 QUALITY ASSURANCE**

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

**1.5 COORDINATION**

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, 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 for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.

2. Documentation: Review the following items in detail:
  - a. Emergency manuals.
  - b. Operations manuals.
  - c. Maintenance manuals.
  - d. Project record documents.
  - e. Identification systems.
  - f. Warranties and bonds.
  - g. Maintenance service agreements and similar continuing commitments.
  
3. Emergencies: Include the following, as applicable:
  - a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
  
4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
  
5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
  
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.

7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
  
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
  
- B. Set up instructional equipment at instruction location.

**3.2 INSTRUCTION**

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
  
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
  2. Owner will furnish an instructor to describe Owner's operational philosophy.
  3. Owner will furnish Contractor with names and positions of participants.

- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- 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.

END OF SECTION 017900



**SECTION 024119 - SELECTIVE DEMOLITION**

**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. Demolition and removal of selected portions of building or structure.
- 2. Salvage of existing items to be reused or recycled.

**B. Related Requirements:**

- 1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
- 2. Section 017300 "Execution" for cutting and patching procedures.

**1.3 DEFINITIONS**

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

**1.4 MATERIALS OWNERSHIP**

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

**1.5 FIELD CONDITIONS**

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

**1.6 COORDINATION**

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Standards: Comply with ASSE A10.6 and NFPA 241.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Survey of Existing Conditions: Record existing conditions and correlate with requirements indicated to determine extent of selective demolition required.



**3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS**

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

**3.3 PREPARATION**

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

**3.4 SELECTIVE DEMOLITION, GENERAL**

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 5. Maintain adequate ventilation when using cutting torches.
  - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  - 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

**B. Removed and Salvaged Items:**

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

**C. Removed and Reinstalled Items:**

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- D. Existing Items to Remain:** Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

### **3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS**

- A. Concrete:** Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete:** Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry:** Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade:** Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings:** Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."
- F. Roofing:** Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
  2. Remove existing roofing system down to substrate.

**3.6 DISPOSAL OF DEMOLISHED MATERIALS**

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

**3.7 CLEANING**

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119



**SECTION 055000 - METAL FABRICATIONS**

**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. Steel framing and supports for mechanical and electrical equipment.
- 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

**B. Related Requirements:**

- 1. Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for materials and methods of suspending plumbing materials from existing building structure.
- 2. Division 23 Section " Hangers and Supports for HVAC Piping and Equipment " for materials and methods of suspending HVAC materials from existing building structure.

**1.3 SUBMITTALS**

- A. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

- 1. Provide templates for anchors and bolts specified for installation under other Sections.

- B. Welding Certificates: Copies of certificates for welding procedures and personnel.

**1.4 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- B. Welding Qualifications: Qualify procedures and personnel according to the following:

- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- 3. AWS D1.3, "Structural Welding Code--Sheet Steel."

4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

**1.5 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
- B. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

**1.6 COORDINATION**

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**PART 2 - PRODUCTS**

**2.1 METALS**

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

**2.2 FERROUS METALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- D. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- E. Gray-Iron Castings: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

- F. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

### 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Bolts: ASME B18.2.1.
- F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
- G. Plain Washers: Round, carbon steel, ASME B18.22.1.
- H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.
- I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.
- J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

### 2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- J. Remove sharp or rough areas on exposed traffic surfaces.
- K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

## 2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as needed to complete the Work.
- B. General: Provide steel framing and supports indicated and as necessary to complete the Work.



- C. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches wide by 1/4 inch thick by 8 inches long at 24 inches o.c., unless otherwise indicated.
  - 3. Furnish inserts if units must be installed after concrete is placed.

## 2.6 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches from each end, 6 inches from corners, and 24 inches o.c., unless otherwise indicated.
- C. Galvanize miscellaneous steel trim in the following locations:
  - 1. Exterior.
  - 2. Interior, where indicated.

## 2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

## 2.8 STEEL AND IRON FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
- B. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

**PART 3 - EXECUTION****3.1 INSTALLATION, GENERAL**

- A. **Fastening to In-Place Construction:** Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- B. **Cutting, Fitting, and Placement:** Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. **Field Welding:** Comply with the following requirements:
  - 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. **Corrosion Protection:** Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

**3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS**

- A. **General:** Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

**3.3 ADJUSTING AND CLEANING**

- A. **Painting:** Cleaning and painting of steel components are specified in Section 099123 "Interior Painting."

**END OF SECTION 055000**



**SECTION 055213 - PIPE AND TUBE RAILINGS**

**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. Aluminum pipe railings for interior applications.

**1.3 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- C. Samples: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
  - 2. Fittings and brackets.
  - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
    - a. Show method of connecting and finishing members at intersections.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

#### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in good conditions and properly protected against damage to finished surfaces.
- B. Store materials in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
- C. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of materials.

#### 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

**A. Aluminum Pipe and Tube Railings:**

1. Manufacturers: Subject to compliance with requirements, provide handrails and railing systems equal to the basis-of-design.
2. Basis-of-Design: Aluminum Ornamental Railing Systems:
  - a. Aluminum Tube Railings manufactured by  
ATR Technologies, Inc.  
805 Towne Center Drive  
Pomona, CA 91767-5901  
Toll Free Phone: (800) 423-4148  
Fax: (909) 399-584  
Website: www-ATR-Technologies.com  
Email: railings@ATR-Technoloies.com

**B. Source Limitations: Obtain each type of railing from single source from single manufacturer.**

**2.2 PERFORMANCE REQUIREMENTS**

**A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:**

1. Handrails and Top Rails of Guards:
  - a. Uniform load of 50 lbf/ ft. applied in any direction.
  - b. Concentrated load of 200 lbf applied in any direction.
  - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - d. These loads shall not be assumed to act cumulatively with those loads on the infill area of guardrail system.
2. Infill Area of Guardrail System: Capable of withstanding the following loads applied as indicated:
  - a. Concentrated load of 25 pounds per square foot applied horizontally at right angles over the entire tributary area, including openings and spaces between rails.
  - b. Reaction due to the above load need not be combined with those loads on the toprail of guardrail system.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature in engineering, fabricating, and installing of joints, overstressing of components and connections, and other detrimental effects. Base engineering calculations on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

### 2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

### 2.4 ALUMINUM

A. General: Provide metal free from surface blemishes. Surfaces exhibiting pitting, seam marks, roller marks, and stains, discolorations or other imperfections on finished units are not acceptable.

B. Aluminum: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

C. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52.

D. Extruded Structural Pipe: ASTM B 429/B 429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.

G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

H. Panel Clips: Alloy 6063-T6.

### 2.5 RAILING SYSTEM

A. Material shall conform to 2.02 and be finished in accordance with 2.07.



- B. Railing system shall be permanently anchored.
- C. Top Rails: Fabricate Top Rails from baked enamel aluminum tube with nominal size of 3 1/2 inch w. x 1 1/2 inch h, part number 1-H.
  - 1. Include flat closure.
- D. Handrails: fabricate handrails from baked enamel aluminum tube with nominal size of 1 3/4 inch w. x 1 1/4 inch h, part number 327.
  - 1. Include flat closure.
- E. Post: fabricate posts from baked enamel aluminum tube with a nominal size of 2 inches w. x 2 inches h. part number 4-G.
  - 1. If required, provide post reinforcement to meet loading criteria.
- F. Mounting Base Plates: Base plates shall be of aluminum attached to ends of Post by means of mechanical attachment. Screws shall be galvanized steel flat socket head machine screws.
- G. Mounting Wall Brackets: Wall brackets shall be aluminum attached to bottom side of handrail by means of mechanical attachment. Screws shall be galvanized steel flat socket head machine screws.

## 2.6 FASTENERS

- A. General: Provide the following:
  - 1. Aluminum Railings: Type 304 stainless-steel fasteners.
  - 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
  - 2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
  - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

**2.7 GROUT AND ANCHORING CEMENT**

- A. Non-shrink, Non-metallic Grout: Premixed, factory-packaged, non-shrink, non-metallic, non-staining, non-corrosive grout. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- B. Products: Subject to compliance with requirements, provide one of the following or equal.
  - 1. Erosion-Resistant Anchoring Cement:
    - a. EMACO GRIP by BASF Building Systems.
    - b. QUIKRETE Commercial Grade FastSet by the QUIKRETE Companies.

**2.8 MISCELLANEOUS MATERIALS**

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
  - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

**2.9 FABRICATION**

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
  - 1. Fabricating railing with non-welded, internal and mechanical connections with no exposed fasteners.

2. Form all changes in rail direction by mitered, hairline mechanical joints.
  3. Cut materials square and remove burrs from all exposed edges, with no chamfer.
  4. Make exposed joints butt tight and flush.
  5. Close exposed visible ends of Toprails and Handrails by use of flat end cap.
  6. Verify dimensions on site prior to shop fabrication.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
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 flux immediately.
  4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Form Changes in Direction as Follows:
1. As detailed.
  2. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
- K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.

- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

#### 2.10 FINSHES, GENERAL

- A. Comply with NAAMM “Metal Finish Manual” for recommendations relative to applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage per manufacturer’s recommendations.
- C. Appearance of Finished Work: To be approved by the Architect.

#### 2.11 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Baked Enamel Paint Finish: Architect to select from manufacturer’s full range of grades, finishes, and colors.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.

- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

### 3.3 ANCHORING POSTS

- A. Use PVC schedule 40 metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
- D. Interior Stairs LD106 and LD 206: Face mount with flanges and stainless steel fasteners supplied by the aluminum railing manufacturer.

**3.4 ATTACHING RAILINGS**

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.
- B. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts. Predrill face brick masonry and anchor to cast concrete or CMU back up. **DO NOT ANCHOR TO FACE BRICK MASONRY.**

**3.5 ADJUSTING AND CLEANING**

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

**3.6 PROTECTION**

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

**END OF SECTION 055213**

**SECTION 062023 - INTERIOR FINISH CARPENTRY**

**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. Interior trim.
- 2. Birch Veneer on 1/2 inch MDF (Stained)

**B. Related Requirements:**

- 1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
- 2. Section 064116 "Plastic-Laminate-Faced Architectural Cabinets".
- 3. Section 099123 "Interior Painting" for priming and back priming of interior finish carpentry.

**1.3 DEFINITIONS**

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
- B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
- C. Shop Drawings: Show locations of each item, dimensional plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show detail full size.
  - 2. Show locations and sizes of furring, blocking, and hanging strips, include concealed blocking and reinforcements specified in other sections.

3. Show locations and sizes of cutouts and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
5. Apply WI-certified compliance label to first page of shop drawings.

D. Samples for Verification:

1. Lumber with or for transparent finish, not less 50 sq. in., for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
3. Veneer-faced mdf panel products with or for transparent finish, 8 by 10, for each species and cut. Include at least one face-veneer seam and finish as specified.
4. Lumber and panel products with shop-applied opaque finish, 50 sq. in., for lumber and 8 by 10 inches for panels, for each finish system and color, with 1/2 of exposed surface finished.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing architectural woodwork as indicated for this project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: An experienced installer who has completed architectural woodwork as indicated 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.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.



**1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
  - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- C. Field Measurements: Where woodwork is indicated, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

**PART 2 - PRODUCTS**

**2.1 MATERIALS, GENERAL**

- A. Interior trim.
- B. Lumber: DOC PS 20.
- C. Softwood Plywood: DOC PS 1.
- D. Hardboard: AHA A135.4.
- E. MDF: ANSI A208.2, Grade 130.

**2.2 FIRE-RETARDANT-TREATED MATERIALS**

- A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction, and comply with testing requirements; testing by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent respectively.

- C. For exposed items indicated to receive a stained or natural finish, use organic resin chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.
- D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.
- E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
  - 2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
- F. Application: Where indicated.

### 2.3 INTERIOR TRIM

- A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
  - 1. Species and Grade: Birch Clear; NHLA.
  - 2. Maximum Moisture Content: 10 percent.
  - 3. Finger Jointing: Not Allowed.
  - 4. Gluing for Width: Not Allowed.
  - 5. Veneered Materials: Not Allowed.
  - 6. Face Surface: Surface (smooth).
  - 7. Matching: Selected for compatible grain and color.
- B. Lumber Trim for Opaque Finish (Painted Finish):
  - 1. Species and Grade: Eastern white pine, Premium.
  - 2. Maximum Moisture Content: 10 percent.
  - 3. Finger Jointing: Not allowed.
  - 4. Face Surface: Surfaced (smooth).
  - 5. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.
- C. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): WMMPA HWM 2, N-grade wood moldings made to patterns included in WMMPA HWM 1.
  - 1. Species: Birch. 1x hardwood trim.
  - 2. Maximum Moisture Content: 9 percent.
  - 3. Finger Jointing: Not allowed.
  - 4. Matching: Selected for compatible grain and color.

- D. Birch Veneer on 1/2 inch MDF (Stain finish).
  - 1. MDF is the substrate for the birch veneer. Density particleboard, medium-density fiberboard to meet ANSI 208.1 or 208.2 standards.
  - 2. Panel edges must be refinished per manufacturer's instructions after field cutting, before installation.
  - 3. Panels must be applied over a smooth, solid, flat backing such as gypsum board. All gypsum board joints be taped and finished. Wall shall be primed and painted before installation begins.
  - 4. C-702 Adhesive (or Equal) solvent based material and local codes restrictions may require substitution. Any adhesive substitution must have manufacturer's approval.
    - a. Avoid contamination of the panel faces with the adhesives, solvents or cleaners during installation.
- E. Contractor responsible for matching factory finish Birch Veneer Stain to field applied running trim. Provide stain samples to architect for approval.
- F. Moldings for Opaque Finish (Painted Finish):
  - 1. Hardwood Moldings: WMMPA HWM 2, P-grade.
    - a. Species: Popular.
    - b. Maximum Moisture Content: 9 percent.
  - 2. Finger Jointing: Allowed.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
  - 1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.
- D. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

**2.5 FABRICATION**

- A. Back out or kerf backs of the following members except those with ends exposed in finished work:
  - 1. Interior standing and running trim except shoe and crown molds.
  - 2. Wood-board paneling.
- B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

**3.3 INSTALLATION, GENERAL**

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
  - 3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

4. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

#### 3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
  1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
  2. Install trim after gypsum-board joint finishing operations are completed.
  3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

#### 3.5 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

#### 3.6 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.
- B. Clean panels and trim according to the manufacturer's recommendations.

#### 3.7 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
  1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

END OF SECTION 062023



**SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS**

**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. Plastic-laminate-faced architectural cabinets.
- 2. Solid surface material for countertops.
- 3. Plastic-laminate-clad countertops
- 4. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including high-pressure decorative laminate, adhesive for bonding plastic laminate, and cabinet hardware and accessories.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show details full size.
  - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 3. Show locations and sizes of cutouts and holes for electrical switches and outlets installed in architectural plastic-laminate cabinets.
- C. Samples for Initial Selection:
  - 1. Plastic laminates.
  - 2. Solid surface materials.
  - 3. PVC edge material
  - 4. Thermoset decorative panels.

## D. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish.
2. Wood-grain plastic laminates, 12 by 24 inches, for each type, pattern and surface finish.
3. Corner pieces as follows:
  - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
  - b. Miter joints for standing trim.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.
5. Solid surface materials.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Product Certificates: For each type of product.
  1. Composite wood and agrifiber products.
  2. Thermoset decorative panels.
  3. High-pressure decorative laminate.
  4. Adhesives.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of products.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.



**1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period. HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

**1.8 COORDINATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

**PART 2 - PRODUCTS**

**2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS**

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
  - 1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
- B. Grade: Premium.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Formica Corporation.
    - b. Nevamar.
    - c. Wilsonart International; Div. of Premark International, Inc.
- F. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces: Grade HGS.
  2. Postformed Surfaces: Grade HGP.
  3. Vertical Surfaces: Grade VGS.
  4. Edges: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish. PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
    - a. Laminate finished; ends, filler panels and upper cabinet boxes are indicated on the Drawings.
  5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Materials for Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
    - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
    - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
  2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
  3. Drawer Bottoms: Thermoset decorative panels.
- H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
1. 1/4 inch plastic laminate back panel.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued dovetail joints.

- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As selected by Architect from laminate manufacturer's full range in the following categories. Refer to the Finish Schedule in the Drawings for selected colors and patterns.
    - a. Solid colors, matte finish.
    - b. Solid colors with core same color as surface, matte finish.
    - c. Wood grains, matte finish.
    - d. Patterns, matte finish.

## 2.2 WOOD MATERIALS

- L. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Wood Moisture Content: 5 to 10 percent.
- M. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
  2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
  3. Softwood Plywood: DOC PS 1.
  4. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8. and 3.10.
    - a. Color: As selected by Architect from manufacturer's full range of colors.

## 2.2 SOLID-SURFACING COUNTERTOPS

- A. Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 of Type 6, without a precoated finished. Available products: Provide products from one of the following:
1. Avonite; Avonite, Inc.
  2. Corian; Dupont Polymer
  3. Durasein
  4. Surell; Formica Corporation.
  5. Gibraltar; Wilsonart International, Div. of Premark International, Inc.
- B. Grade: Premium.
- C. Solid-Surfacing-Materials Thickness – 1/2 inch.

- D. Colors, Patterns, and finishes: Provide materials and products that result in colors of solid-surfacing material complying with the follow requirements:
  - 1. Provide Architect's selections from manufacturer's full range of grades, colors, and finishes.
- E. Fabricate top in one piece with shop-applied covered integral backsplash and eased edges, unless otherwise indicated in the Drawings. Comply with countertop and material manufacturer's written recommendations for adhesives, sealers, and fabrication, and finishing.
  - 1. Undermount Sink: equal to Kohler, K2210 White.
- F. Drill holes in countertops for plumbing fitting shop.
- G. Solid surface shelf and window stool: as indicated on the Drawings.

### 2.3 PLASTIC LAMINATE CLAD COUNTERTOPS

- A. Quality Standard: Comply with AWI section 400 and its Division 400C.
- B. Type of Top: High pressure decorative laminate complying with the following:
  - 1. Grade: Premium.
  - 2. Laminate Cladding for Horizontal Surface: High Pressure decorative laminate as follows:
    - a. Color, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
      - 1) Provide Architect's selections from manufacturer's full range of grades, colors, and finishes.
    - b. Grade: GP-50 (0.050-inch nominal thickness).
  - 3. Edge Treatment: Same as laminate cladding on horizontal surfaces or as indicated.
  - 4. Backsplash: Provide integral backsplash with rolled top edge.
  - 5. Front Edge: Refer to drawings for front edge details.

### 2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
  - 1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
  - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
  2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
  3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
  4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

## 2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- C. Back-Mounted Pulls: BHMA A156.9, B02011 equal to Century BCO Bow Pull, 3 3/4 inch hole center, satin nickel.
- D. Drawer Slides: Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
1. Heavy-Duty Extension Slides: Side mounted slide equal to Accuride 3640. Bright electric-zinc, side mount - 2.09, 200 lbs load rated.
  2. Box Drawer Slides: 100 lbf.

3. File Drawer Slides: 200 lbf.
  4. Pencil Drawer Slides: 45 lbf.
  5. Trash Bin Slides: 200 lbf.
- E. Door Locks: BHMA A156.11, E07121.
- F. Drawer Locks: BHMA A156.11, E07041.
- G. Door and Drawer Silencers: BHMA A156.16, L03011.
- H. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Architect to select finish.
1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
  2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
  3. Bright Brass, Vacuum Coated: BHMA 723 for brass base; BHMA 729 for zinc-coated-steel base.
  4. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
  5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
  6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
  7. Satin Stainless Steel: BHMA 630.
- I. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- F. Aluminum Channel Reveal Strip: as indicated on the Drawings.

**2.7 FABRICATION**

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate cabinets to dimensions, profiles, and details indicated.
- C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
  - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- D. Shop-cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

**3.2 INSTALLATION**

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
  - 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
  - 2. Seal edges of cutouts with varnish.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood blocking.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align countertops and form seams to comply with manufacturer's written recommendations using adhesives in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from straight line.
  3. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."



4. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
  - a. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116



## SECTION 081476 – BIFOLDING WOOD DOORS

## PART 1 - GENERAL

## 1.01 DESCRIPTION

## A. General

1. Furnish and install operable glass partitions and suspension system. Provide all labor, materials, tools, equipment, and services for glass operable walls (bifolding doors) in accordance with provisions of contract documents.

## 1.02 RELATED WORK BY OTHERS

- A. Preparation of opening will be by General Contractor. Any deviation of site conditions contrary to approved shop drawings must be called to the attention of the architect.
- B. All header, blocking, support structures, jambs, and track enclosures, as required in 1.04 Quality Assurance.
- C. Prepunching of support structure in accordance with approved shop drawings.
- D. Paint or otherwise finishing all trim and other materials adjoining head and jamb of the partitions.

## 1.03 SUBMITTALS

- A. Complete shop drawings are to be provided prior to fabrication indicating construction and installation details. Shop drawings must be submitted within 60 days after receipt of signed contract.

## 1.04 QUALITY ASSURANCE

- A. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
- B. Glass shall be clear tempered per ASTM C1048-97b.

## 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Proper storage of partitions before installation and continued protection during and after installation will be the responsibility of the General Contractor. **IMPORTANT:** Room in which panels are stored and/or installed must be temperature and moisture controlled.

## 1.06 WARRANTY

Track, carriers, and panel frames shall be guaranteed for one year against defects in material and workmanship. The glass is not included in this warranty.

## PART 2 - PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

- A. Upon compliance with all of the criteria specified in this section, Manufacturers wishing to bid products similar to the product specified must show thorough evidence of equal material, manufacturing, performance and aesthetics of the basis-of-design product.

## 2.02 MATERIALS

- A. Product to be equal to top supported, center stacked, Series GT2 paired wood-framed glass panels as manufactured by Hufcor.
  1. Panels shall be nominally 1-3/4" [43mm] thick and to 48" [1219] in width.
  2. Wood frame of triple laminated solid wood top and bottom rails and stiles that are constructed from custom made veneers with an engineered wood core.
    - a. Basis of design is Oak

3. Vertical lead rails shall contain full height partially recessed rubber bulb seal
  4. Horizontal top & bottom rails shall incorporate continuous contact seals of brown multiply vinyl.
  5. Each panel contains a mortise floor pin which extends into a floor mounted plate to stabilize and secure each panel in the opening.
  6. Glass inserts shall be:
    - a. 1/4" [6mm] tempered glass
  7. Glass shall be glazed using matching solid wood stops on one side of panel.
  - B. Weight of the panels shall be approximately:
    - 1/4" [6mm] tempered glass: 7.5 lbs. per sq. ft.
  - C. Suspension system:
    1. Track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track design shall provide integral support for adjoining ceiling, soffit, or plenum sound barrier. Track shall be connected to the structural support by pairs of 3/8" [10] dia. threaded steel hanger rods.
      - a. Each panel shall be supported by one 4-wheeled carrier. Wheels to be of hardened steel ball bearings encased with molded polymer tires.
  - D. Finishes
    1. Aluminum track shall be clear anodized
    2. Wood frame shall be furnished stained and finished with a matte polyurethane FROM FACTORY.
      - a. Select stain color from manufacturer's standard selections AND premium stains to match existing woods at project site.
      3. Hardware finish to be Satin Nickel
  - E. Available Accessories/Options
    1. Floor Locks
      - b. Adams Rite keyed floor lock
- 2.03 OPERATION
- A. Panels shall be manually moved from the storage area, positioned in the opening, and either edge activated or face activated floorbolts set.
  - B. Final partition closure to be by overlapping the opening
  - C. Stack/Store Panels
    1. Retract floorbolt and move to storage area.

### PART 3 - EXECUTION

- A. Installation. The complete installation of the glass wall system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer's standard printed specifications, instructions, and recommendations.
- B. Cleaning
  1. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil per specific instructions.
  2. Optional specialty glass requires special cleaning per instructions provided.
  3. Cartoning and other installation debris shall be removed to on-site waste collection area, provided by others.
- C. Training
  1. Installer shall demonstrate proper operation and maintenance procedures to owner's representative.
  2. Owners manuals shall be provided to owner's representative.

END OF SECTION 081476

**SECTION 083113 - ACCESS DOORS AND FRAMES**

**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 and frames for general access.

**B. Related Requirements:**

- 1. Section 092900 "Gypsum Board" for access doors and frames installed in gypsum board assemblies.

**1.3 ACTION SUBMITTALS**

**A. Product Data:** For each type of product.

- 1. Include construction details, materials, individual components and profiles, and finishes.

**B. Shop Drawings:**

- 1. Include plans, sections, details, and attachments to other work.
- 2. Detail fabrication and installation of access doors and frames for each type of substrate.

**PART 2 - PRODUCTS**

**2.1 ACCESS DOORS AND FRAMES FOR CEILINGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. Acudor Products, Inc.
- 2. Babcock-Davis.
- 3. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
- 4. Larsen's Manufacturing Company.
- 5. Milcor Inc.

- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Fire-Rated and non-rated, Flush Access Doors with Exposed Flanges:
  - 1. Basis-of-Design Product: Babcock Davis, Model BNT-24x24- G.
    - a. Size: 24 inch by 24 inch at typical locations requiring access. 36"x36" at attic access hatch.
    - b. Gasketed.
  - 2. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
  - 3. Locations: Ceiling for general access.
  - 4. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage.
    - a. Finish: Factory finish.
  - 5. Frame Material: Same material, thickness, and finish as door.
  - 6. Hinges: Continuous piano hinge, upward acting. .
  - 7. Hardware: Prep for cylinder lock as specified in Section 087100 "Door Hardware."

## 2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same type as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. Provide mounting holes in frames for attachment of units to metal framing.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

## 2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel Finishes:

1. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil for topcoat.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

### 3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113



**SECTION 088000 - GLAZING**

**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. Extent of glass and glazing work is indicated on drawings and schedules.
- B. Types of work in this section include glass and glazing for:
  - 1. Interior glazing.

**1.3 SYSTEM DESCRIPTION:**

- A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.
  - 1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120 deg. F and from a consequent temperature range within glass and glass framing members of 180 deg. F.
  - 2. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.
  - 3. Deterioration of coated glass is defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in metallic coating due to normal conditions of use.

**1.4 SUBMITTALS:**

- A. Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.
- B. Samples: Submit, for verification purposes, 12" square samples of each type of glass indicated except for clear single pane units, and 12" long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color.

**1.5 QUALITY ASSURANCE:**

- A. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.
- B. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.
  - 1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.
- C. Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.

**1.6 DELIVERY, STORAGE, AND HANDLING:**

- A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.

**1.7 PROJECT CONDITIONS:**

- A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.

**1.8 WARRANTY:**

- A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include; but are not limited to, the following:
  - 1. Manufacturers of Clear and Tinted Float Glass:
    - a. AFG Industries, Inc.

- b. Ford Glass Division.
- c. Guardian Industries Corp.
- d. LOF Glass, Inc.
- e. PPG Industries, Inc.
- f. Saint-Gobain/Euroglass.

**2.2 GLASS PRODUCTS, GENERAL:**

- A. Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.
- B. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.
- C. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

**2.3 HEAT-TREATED GLASS PRODUCTS:**

- A. Manufacturing Process: Manufacture heat-treated glass as follows:
  - 1. By vertical (tong-held) or horizontal (roller hearth) process, at manufacturer's option. Tong marks are permitted only if they will be concealed in glazing channel.
- B. Uncoated Clear Heat-Treated Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.
  - 1. Kind FT (fully tempered) all applications.

**2.4 GLAZING SCHEDULE:**

- A. Glass Type GL-1: Mirror glass (M-1 designation in the Drawings).
  - 1. Float Glass.
  - 2. Thickness: 1/4 inch.
  - 3. Edge Treatment: Ground
  - 4. Mounting: Concealed cleat with top and bottom channels.
    - a. CRLD160A top and bottom channels.
    - b. CRLD1637M Cleat, top channel only.
- B. GLAZING GASKETS:

- C. Lock-Strip Gaskets: Neoprene extrusions of size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542; black.
- D. Dense Elastomeric Compression Seal Gaskets: Molded or extruded gaskets of material indicated below, complying with ASTM C 864, of profile and hardness required to maintain watertight seal:
  - 1. Neoprene.
  - 2. EPDM.
  - 3. Thermoplastic polyolefin rubber.
  - 4. Any material indicated above.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
  - 1. Manufacturers of Lock-Strip Gaskets:
    - a. Cadillac Rubber & Plastics, Inc.
    - b. Maloney Precision Products Co.
    - c. The Standard Products Co.
  - 2. Manufacturers of Preformed Gaskets:
    - a. D. S. Brown Co.
    - b. Maloney Precision Products Co.
    - c. Tremco.

**2.5 MISCELLANEOUS GLAZING MATERIALS:**

- A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Require Glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain Glazier's written report listing conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

**3.2 PREPARATION:**

- A. Pre-Installation Meeting: At Contractor's direction, Glazier, sealant and gasket manufacturers' technical representatives, glass framing erector and other trades whose work affects glass and glazing shall meet at project site to review procedures and time schedule proposed for glazing and coordination with other work.
- B. Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

**3.3 GLAZING, GENERAL:**

- A. Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.
- B. Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.
- C. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

**3.4 GLAZING:**

- A. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.
- B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
- C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.
- D. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

- E. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.
- F. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
- G. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.
- H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.
- I. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- J. Lock-Strip Gasket Glazing: Comply with ASTM C 716 and gasket manufacturer's printed recommendations. Provide supplementary wet seal and weep system unless otherwise indicated.

### 3.5 PROTECTION AND CLEANING:

- A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, remove by method recommended by glass manufacturer.
- D. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.
- E. Wash glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer.

END OF SECTION 088000

**SECTION 092216 - NON-STRUCTURAL METAL FRAMING**

**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. Non-load-bearing steel framing systems for interior partitions.
  - 2. Suspension systems for interior ceilings and soffits.

**1.3 ACTION SUBMITTALS**

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

**1.4 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

**PART 2 - PRODUCTS**

**2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL**

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating, unless otherwise indicated.

## 2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch diameter wire, or double strand of 0.0475 inch diameter wire.
- B. Hanger Attachments to Steel Framing:
  - 1. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
  - 1. Depth: 2-1/2 inches.
- E. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538 inch bare-steel thickness, with minimum 1/2-inch wide flanges, 3/4 inch deep.
  - 2. Steel Studs: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.0179 inch.
    - b. Depth: As indicated on Drawings.
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base Metal Thickness: 0.0179 inch.
- F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; 640-C Drywall Furring System.
    - c. USG Corporation; Drywall Suspension System.

## 2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: As indicated on Drawings 0.0179 inch.



## B. Slip-Type Head Joints: Where indicated, provide the following:

1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

## C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
  - a. Fire Trak Corp.: Fire Trak attached to studs with Fire Trak Slip Clip.
  - b. Metal-Lite, Inc., The System.
  - c. Dretrich Metal Framing, Inc.

## D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0179 inch.

## E. Cold-Rolled Channel Bridging: 0.0538 inch bare-steel thickness, with minimum ½ inch wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

## F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: As indicated on Drawings 0.0179 inch.
2. Depth: 7/8 inch

## G. Cold-Rolled Furring Channels: 0.0538 inch bare-steel thickness, with minimum ½ inch wide flanges.

1. Depth: 3/4 inch.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch diameter wire, or double strand of 0.0475 inch diameter wire.

## 2.4 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

- B. Isolation Strip at Exterior Walls: Provide the following:
  - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

#### 3.3 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- B. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
  - 3. Do not attach hangers to steel roof deck.
  - 4. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb, unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2 inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- C. Direct Furring:
  - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216



**SECTION 092900 - GYPSUM BOARD**

**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. Interior gypsum board.

B. Related Requirements:

- 1. Section 092216 "Non-structural Metal framing" for non-structural steel framing and suspension systems that support gypsum board panels.

**1.3 ACTION SUBMITTALS**

A. Product Data: For each type of product.

B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

**1.4 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

- 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

- B. Barrier Conditions: The building perimeter envelope shall act as an air barrier by sealing the gypsum board assembly where it abuts the roof decking around the building's perimeter and as indicated in the Drawings. Provide all materials and accessories as specified to achieve a continuously sealed barrier.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

## 2.1 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Gypsum Co.
    - b. BPB America Inc.
    - c. G-P Gypsum.
    - d. National Gypsum Company.
    - e. USG Corporation.
- B. Type X:
  - 1. Thickness: 5/8 inch.
  - 2. Long Edges: Tapered.
- C. Ceiling Type:
  - 1. Type X.
  - 2. Thickness: 5/8 inch.
  - 3. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.

## 2.2 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
  - a. Corner bead: Use at outside corners.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. U-Bead: J-shaped; exposed short flange does not receive joint compound.Expansion (control) joint: Provide in full height walls at locations indicated in the Drawings. At fire rate/sound partitions, provide fire safing/sound attenuation insulation to maintain fire /sound rating.

## 2.3 JOINT TREATMENT MATERIALS

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

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
  - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

## 2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

**PART 3 - EXECUTION**

**3.1 APPLYING AND FINISHING PANELS, GENERAL**

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

**3.2 APPLYING INTERIOR GYPSUM BOARD**

- A. Install interior gypsum board in the following locations:
  - 1. Type X: As indicated on Drawings.
  - 2. Ceiling Type: Ceiling surfaces.
  - 3. Moisture and Mold-Resistant Type: At the following locations:
    - a. Walls and Ceilings of housekeeping closets, toilets, and other areas exposed to excessive moisture or damp conditions.

**3.3 INSTALLING TRIM ACCESSORIES**

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.



- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners.
  - 2. LC-Bead: Use at exposed panel edges.
  - 3. L-Bead: Use where indicated.
  - 4. U-Bead: Use at exposed panel edges.
  - 5. Expansion (control) joints: Install at locations indicated.

**3.4 FINISHING GYPSUM BOARD**

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- C. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 3: Where indicated on Drawings.
  - 3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in other Division 9 Sections.

**3.5 PROTECTION**

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- C. Permanently label fire rated assemblies by stenciling the designated fire rating on the surface of each side of the partition and/or wall, above accessible ceiling areas and/or in locations not open to public view.
  - 1. Such labels shall be in letters 4" high, stenciled in red paint, spaced a maximum of 20 feet horizontally, 6 inches above accessible ceilings or 10 feet above finished floor in areas without ceilings.

2. When located each side of a wall, the labels shall be staggered such that one label is not located directly opposite another along a wall.
  3. Locate labels on each side of a corner where fire rated walls change direction.
- D. Where structural members penetrate fire rated gypsum board assemblies, neatly cope gypsum board assemblies around the structural member, provide metal stud framing around the perimeter of the coped opening as support for the gypsum board edges, fill voids and treat surfaces to comply with the requirements of U.L design HW-D-0192, using materials and methods specified in Division 7 Section “Through-Stop Penetration Systems”.

END OF SECTION 092900

**SECTION 095113 - ACOUSTICAL PANEL CEILINGS**

**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. This Section includes:
  - 1. Acoustical ceiling tiles with grid suspension systems
  - 2. Wire hangers, fasteners, main runners, and cross tees.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Submit manufacturer's technical data for each type of ceiling and suspension system required.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
  - 1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.
  - 3. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not limited to, the following: Single source materials suppliers; Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Size and location of initial access modules for acoustical panels.

4. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.

5. Perimeter moldings.

- B. Shop Drawings: Illustrating the layout and details of the ceilings. Show locations of items that are to be coordinated with or supported by the ceilings.
- C. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- D. All products not conforming to Basis-of-Design Manufacturer's current published values must be removed and disposed. Replace with complying product at the expense of the Contractor performing the work.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

#### 1.7 WARRANTY

- ~~A. Wood Veneer Panel and Acoustical Tiles: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period.~~

- ~~1. Acoustical Panels: Sagging and warping.~~
- ~~2. Ceiling Panels: Defects in materials or factory workmanship.~~
- ~~3. Grid System: Rusting and manufacturer's defects.~~

- B. Warranty Period (all tiles and grid systems):

1. Acoustical Panels: One (1) year from date of installation.
- ~~2. Wood Veneer Panels: One (1) year from date of installation.~~
3. Grid: One (1) year from date of installation.

- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Manufacturer and Contractor under the requirements of the Contract Documents.

**1.8 MAINTENANCE MATERIAL SUBMITTALS**

- A. Deliver extra materials to Owner. Furnish extra materials described below that match product installed, are packaged with protective covering for storage, and are identified with appropriate labels.
  - 1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
  - 2. ~~Wood Veneer Panels: Furnish quantity of full-size units equal to 5.0 percent of amount installed.~~
  - 3. Exposed Suspension System Components: Furnish quantity of each exposed components equal to 2.0 percent of amount installed.

**1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver acoustical panels, wood veneer ceiling panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels and wood veneer ceiling panels carefully to avoid chipping edges or damaging units in any way.

**1.10 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.
- B. Do not install the wood veneer panels in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.
- C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
  - 2. Smoke-Developed Index: 50 or less.
- C. ~~Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.~~
- D. ~~Woodworks Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possible delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designer and installer are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.~~
- E. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, wet work, i.e. gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

## 2.2 ACOUSTICAL PANELS, GENERAL

- A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

## 2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc. or comparable product by one of the following:
1. Armstrong World Industries, Inc.
    - a. Ceiling Type 1 – Armstrong Cortega #770, 15/16” grid.
  2. CertainTeed Corp.
  3. Rockfon
  4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
1. Ceiling Type 1 – Armstrong Cortega #770, 15/16” grid.
    - a. Type and Form: Type III, mineral based with painted finish; Form 2, water felt.
    - b. Pattern: CD (perforated, small holes and fissured.)
    - c. Color: White
    - d. LR: Not less than 0.82.
    - e. NRC: Not less than 0.55.
    - f. CAC: Not less than 35.
    - g. Edge/Joint detail: Square, Prelude 15/16” Exposed Tee.
    - h. Thickness: 5/8 inch
    - i. Modular Size: 24 by 24 inch.
    - j. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21

## 2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, 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 according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Cast-in-place anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

## 2.5 METAL SUSPENSION SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc. Prelude 15/16 inch, or comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. Hunter Douglas
5. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 9/16-inch- wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Aluminum cold-rolled sheet.
5. Cap Finish: Painted to match color of acoustical unit.

C. Metal Linear Panel: Standard carrier and carrier splices. Provide metal panel end caps and standard carrier moulding.



## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering, and painting has been completed and thoroughly dried out.
- D. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

## 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Install wall moldings at intersection of suspended ceiling and vertical surfaces.
- C. For reveal edge panels: cut and reveal or rabbet edges of ceiling panels at boarder areas and vertical surfaces.
- D. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. 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.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- A. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- C. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- D. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. Install panels with pattern running in one direction parallel to long axis of space.
  2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.
- E. Install linear metal panels securely to carriers, plumb, aligned and fully integrated. Provide trim and caps for a neat finished appearance.

#### 3.4 CLEANING

- A. Replace damage and broken panels.
- B. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION



**SECTION 096513 - RESILIENT BASE AND 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. Resilient base.
  - 2. Resilient stair accessories.
  - 3. Resilient molding accessories.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- D. Product Schedule: For resilient base and accessory products.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

**1.6 FIELD CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

**PART 2 - PRODUCTS**

**2.1 THERMOPLASTIC-RUBBER BASE**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  - 3. Flexco.
  - 4. Johnsonite; A Tarkett Company.
  - 5. Mondo Rubber International, Inc.
  - 6. Roppe Corporation, USA – Basis-of-Design.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
  - 1. Group: I (solid, homogeneous).
  - 2. Style: Coved with toe
- C. Thickness: 1/8 inch.
- D. Height: 4 inches-coved.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Color: Roppe #194 Burnt Umber.

**2.2 RUBBER STAIR ACCESSORY**

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  - 3. Flexco.
  - 4. Johnsonite; A Tarkett Company.
  - 5. Mondo Rubber International, Inc.
  - 6. Roppe Corporation, USA – Basis-of-Design.
- C. Stair Treads: ASTM F 2169.
  - 1. Type: #96 Raised Circular Vantage Design, with Abrasive Strip, Rubber Stair Treads with Integrated Riser. Matching landings.
  - 2. Class: 2 Pattern; Embossed Raised Round.
  - 3. Group: 2 with contrasting color for the visually impaired.
  - 4. Nosing Style: Hinged square nose.
  - 5. Nosing Height: 1-1/2 inches.
  - 6. Thickness: 1/4 inch and tapered to back edge.
  - 7. Size: Length and depths to fit each stair tread one piece or for treads exceeding the maximum lengths manufactured, in equal-length units.
  - 8. Integral Risers: Smooth, flat; in height that fully covers substrates.
- D. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
  - 1. Thickness: Manufacturer's standard.
- E. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- F. Locations: Provide rubber stair accessories in areas indicated.
- G. Colors and Patterns: #194 Burnt Umber, Raised Round Disks.

**2.3 RUBBER MOLDING ACCESSORY**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Johnsonite; A Tarkett Company.
  - 2. Roppe Corporation, USA – Basis-of-Design.
  - 3. Flexco.
- B. Description: Rubber carpet edge for glue-down applications, reducer strip for resilient flooring, joiner for tile and carpet, and transition strips.
  - 1. Roppe #43 Carpet Edging 1/4 inch is to be used when transitioning from Carpet Tiles to Luxury Vinyl Tiles.
  - 2. Roppe #22 Reducer Strip 1/8 inch is to be used when transitioning from solid vinyl tile to sealed concrete or existing flooring.
  - 3. Roppe #206 Nosing 1/4" double undercut stair nosing to be used at the nosing of all carpeted risers.
- C. Profile and Dimensions: Manufacturer’s standard selection.
- D. Locations: Edges and transitions of dissimilar flooring materials.
- E. Colors and Patterns: As selected by Architect from full range of industry colors.

**2.4 INSTALLATION MATERIALS**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



1. Installation of resilient products indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
  1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. **Do not stretch resilient base during installation.**
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  2. Tightly adhere to substrates throughout length of each piece.
  3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

**3.5 CLEANING AND PROTECTION**

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

## SECTION 096519 - RESILIENT TILE FLOORING

## 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. Luxury vinyl floor tile.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
  - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- C. Samples: Full-size units of each color, texture, and pattern of floor tile required.
  - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than **9 inches** long, of each color required.
- D. Samples for Initial Selection: For each type of floor tile indicated.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every **50** boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
- B. Test Results: Moisture, adhesion and alkalinity test results.
- C. Source Limitations: Obtain each type, color, and pattern of floor covering specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

#### 1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 deg F** or more than **95 deg F**, in spaces to receive floor tile during the following periods:
  1. 48 hours before installation.
  2. During installation.
  3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 deg F** or more than **95 deg F**.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

**2.2 LUXURY VINYL FLOOR TILE**

- A. Manufacturer: Subject to compliance with the requirements of the Basis-of-Design, J&J Flooring “Legend 5mm V5010” or equal product.
- B. Wear layer: 20 mil.
- C. Thickness: 5 mm
- D. Size: 18 inch x 36 inch.
- E. Colors and Patterns: 1059 Fiction
- F. Wear Layer: Enhanced UV Urethane with Ceramic Bead.
- G. Pattern Repeat: Random
- H. Standard Adhesive: Commercialon® LVT Adhesive
- I. Backing Class: Commercial Grade
- J. Commercial Traffic: Heavy Commercial
- K. Standard Warranties: 10 years

**2.3 INSTALLATION MATERIALS**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
  1. Adhesives shall comply with the following limits for VOC content:
    - a. Luxury Vinyl Tile Flooring Adhesives: 0 g/L.
      - 1) Per Manufacturer’s written recommendation.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
  1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  4. Moisture Testing: Perform tests so that each test area does not exceed **1000 sq. ft.** and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft.** in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.

- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles: In pattern provided by Interior Designer during submittals.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles In pattern provided by Interior Designer during submittals.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 096519





SECTION 096813 - TILE CARPETING

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 modular carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
  - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
  - 2. Carpet tile type, color, and dye lot.
  - 3. Type of subfloor.
  - 4. Type of installation.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
  - 1. Carpet Tile: Full-size Sample.
- D. Samples for Initial Selection: For each type of carpet tile.
  - 1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.
- E. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
  - 1. Carpet Tile: Full-size Sample.

- F. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to **5** percent of amount installed for each type indicated, but not less than **10 sq. yd.**

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the **Commercial II**.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

#### 1.9 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

**1.10 WARRANTY**

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, the following:
    - a. More than 15 percent edge raveling, snags, and runs.
    - b. Dimensional instability.
    - c. Excess static discharge.
    - d. Loss of tuft-bind strength.
    - e. Loss of face fiber.
    - f. Delamination.
  - 3. Warranty Period: **15** years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 CARPET TILE TYPE 1**

- A. Manufacturers: Subject to compliance with the requirements of the Basis-of-Design, J&J Flooring “Tranquil Modular 7593” or equal product.
  - 1. Construction: Tip Sheared Patterned Loop
  - 2. Color: 3228 Sky
  - 3. Pattern: Monolithic.
  - 4. Backing System: Nexus®
  - 5. Dye Method: Solution Dyed.
  - 6. Fiber Type: Encore® SD Ultima
  - 7. Face Weight: 27 oz. / sy
  - 8. Gauge: 1/12
  - 9. Standard Size: 24 inch x 24 inch

**2.2 CARPET TILE TYPE 2**

- A. Manufacturers: Subject to compliance with the requirements of the Basis-of-Design, J&J Flooring "City Block II 7202" or equal product.
  - 1. Construction: Textured Patterned Loop
  - 2. Color: 2103 Freedom Square
  - 3. Pattern: Quarter Turn
  - 4. Backing: Nexus® Modular
  - 5. Dye Method: Solution/Yarn Dyed
  - 6. Fiber Type: Encore® BCF
  - 7. Face Weight: 18 oz. /y3
  - 8. Gauge: 1/12
  - 9. Standard Size: 24 inch x 24 inch

**2.3 INSTALLATION ACCESSORIES**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
- C. Metal Edge/Transition Strips: Extruded aluminum with aluminum finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
  - 1. Per Basis-of-Design Manufacturer, new concrete needs at least 90 days to dry under ideal conditions. Lightweight concrete and concrete poured above grade in metal pans take a considerably longer time to dry. Installation cannot begin until it is fully dried and in compliance with moisture and alkalinity requirements.

2. Moisture Testing: Perform tests so that each test area does not exceed **200 sq. ft.**, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
  - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft.** in 24 hours.
  - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 80 percent relative humidity level measurement.
3. Interface allows for carpet tiles installation under a variety of conditions depending on the slab and the moisture and pH test results at time of installation:
  - a. For glue-down installation the concrete has to be 80% rH and pH up to 9.0, before carpet tiles can be installed.
  - b. Moisture and pH results reflect only the conditions of the concrete at the time of testing. If the moisture and/or pH test results are outside of the state of allowable limits, STOP and DO NOT PROCEED with the installation.
4. Moisture Testing: the required pre-installation moisture and alkalinity test should be preformed to ASTM standards.
5. Per CRI guidelines it is recommended that these test be performed by a qualified independent testing consultant.
6. Interface will not be responsible for failures, problems, or damage arising from high moisture, high alkalinity, or other subfloor conditions.
7. Before installing, all concrete floors, regardless of age, must comply with the moisture and pH requirements specified per manufacturer, and must be suitable for carpet installation.
8. The moisture conditions of the concrete must be determined by use of the In Situ probe relative humidity (rH) test method ASTM F 2170. Interface requires the use of a moisture testing device manufactured by Wagner or Vasela. The testing device must be properly maintained and calibrated in accordance with the manufacturer's specifications and frequency recommendations. Certificates of calibration must be maintained for test validation.
9. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks,

holes and depressions **1/8 inch** wide or wider, and protrusions more than **1/32 inch** unless more stringent requirements are required by manufacturer's written instructions.

- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: **Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.**
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns **recommended in writing by carpet tile manufacturer.**
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.
- I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

**3.4 CLEANING AND PROTECTION**

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813





## SECTION 096816 - SHEET CARPETING

## 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. Tufted carpet.
- 2. Woven carpet.
- 3. Carpet cushion.

## B. Related Requirements:

- 1. Section 024119 "Selective Demolition" for removing existing floor coverings.
- 2. [Section 096513 "Resilient Base and Accessories"] [Section 096519 "Resilient Tile Flooring"] for resilient wall base and accessories installed with carpet.
- 3. Section 096813 "Tile Carpeting" for modular carpet tiles.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

- 1. Review methods and procedures related to carpet installation including, but not limited to, the following:
  - a. Review ambient conditions and ventilation procedures.
  - b. Review subfloor preparation procedures.
  - c. <Insert agenda items>.

## 1.4 ACTION SUBMITTALS

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

- 1. Include manufacturer's written data on physical characteristics and durability.
- 2. Include manufacturer's written installation recommendations for each type of substrate.

- B. Shop Drawings: For carpet installation, showing the following:
1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
  2. Carpet type, color, and dye lot.
  3. Locations where dye lot changes occur.
  4. Seam locations, types, and methods.
  5. Type of subfloor.
  6. Type of installation.
  7. Pattern type, repeat size, location, direction, and starting point.
  8. Pile direction.
  9. Types, colors, and locations of insets and borders.
  10. Types, colors, and locations of edge, transition, and other accessory strips.
  11. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet: 12-inch- (300-mm-) square Sample.
  2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Samples for Initial Selection: For each type of product.
1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.
- E. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet: 12-inch- (300-mm-) square Sample.
  2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- F. Product Schedule: For carpet. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Carpet: Full-width rolls equal to **5** percent of amount installed for each type indicated, but not less than **10 sq. yd. (8.3 sq. m)**.

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the **Commercial II** and/or **Master II** certification level.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  1. Build mockups at locations and in sizes shown on Drawings.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Carpet and Rug Institute's CRI 104.
- B. Deliver carpet in original mill protective covering with mill register numbers and tags attached.

#### 1.10 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

## 1.11 WARRANTY

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
  2. Failures include, but are not limited to, the following:
    - a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
    - b. Loss of tuft bind strength.
    - c. Excess static discharge.
    - d. Delamination.
  3. Warranty Period: **10** years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 BOARDLOOM CARPET

- A. Manufacturers: Subject to compliance with the requirements of the Basis-of-Design, J&J Flooring "Tranquil Broadloom 6593" or equal product.
1. Construction: Tip Sheared Patterned Loop
  2. Color: 3228 Sky
  3. Backing System: PremierBac® Plus
  4. Dye Method: Solution Dyed.
  5. Fiber Type: Encore® SD Ultima
  6. Face Weight: 27 oz. / sy
  7. Pattern Repeat: 72 inches wide x 59 inches long
  8. Gauge: 1/12
  9. Standard Width: 12 feet
  10. Pile Density: 10.67 stiches / inch
- B. Applied Treatments:
1. Applied Soil-Resistance Treatment: **Manufacturer's standard material** .
  2. Antimicrobial Treatment: [**Manufacturer's standard material**] <Insert treatment>.
    - a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
- C. Performance Characteristics:
1. Critical Radiant Flux Classification: Not less than [**0.45 W/sq. cm**] [**0.22 W/sq. cm**] according to NFPA 253.
  2. Dry Breaking Strength: Not less than **100 lbf (445 N)** according to ASTM D2646.

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by **carpet** manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by **carpet manufacturer**.
- C. Metal Edge/Transition Strips: Extruded aluminum with [mill] <Insert finish> finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance.
- B. Examine carpet for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed **1000 sq. ft.** and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft.** in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by **adhesive and carpet** manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch** wide or wider, and protrusions more than **1/32 inch**, unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by **adhesive and carpet** manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

## 3.3 INSTALLATION

- A. Comply with the Carpet and Rug Institute's CRI 104 and **carpet manufacturer's** written installation instructions for the following:
  - 1. Direct-glue-down installation.
  - 2. Stair installation (Riser).
- B. Comply with carpet manufacturer's written instructions and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Install **as indicated on Drawings**.
- D. Do not bridge building expansion joints with carpet.
- E. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- F. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on subfloor. Use nonpermanent, nonstaining marking device.

## 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.

2. Remove yarns that protrude from carpet surface.
  3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with the Carpet and Rug Institute's CRI 104.
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by carpet manufacturer **and carpet adhesive manufacturer.**

END OF SECTION 096816





## SECTION 098319 – ACOUSTICAL WALL PANELS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work of this section.

## 1.2 SUMMARY

## A. Section Includes:

- 1. Acoustical wall panels and installation components.

## B. Related Sections:

- 1. Section 09 20 00 - Plaster and Gypsum Board
- 2. Division 26 Sections – Electrical Work

## C. Alternates

- 1. Prior Approval: Unless otherwise provided for in the Contract Documents, proposed product substitution may be submitted no later than Ten (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products which have not been approved by Addenda, the specified products shall be provided without additional compensation.
- 2. Submittals which do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of the section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in component profiles and sizes; Compliance with the referenced standards.

## 1.3 REFERENCES

## A. Test Methods:

- 1. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- 2. ASTM E 84/CAN/ULC S102 Standard Test Method for Surface Burning Characteristics of Building Materials.
- 3. CAN/ULC S102 Standard Test Method for Surface Burning Characteristics of Building Materials.

## 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of acoustical wall panel required.
- B. Sample: Minimum 3 inch x 3 inch samples of specified acoustical wall substrate; minimum 4 inches long samples of attachment method including trim and decorative accents.
- C. Shop Drawings: Submit shop drawings showing how panels are to be laid out on the wall, detail of trim members and width of panels. Width of panels and location of vertical seams are critical.

## 1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panels units and installation components by a single manufacturer.
- B. Fire Performance Characteristics: Identify acoustical wall components with appropriate markings of applicable testing and inspecting organization.
  - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84,
    - a. Flame Spread: 25 or less
    - b. Smoke Developed: 200 or less
- C. Coordination of Work: Coordination acoustical wall work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinkler.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical wall panels to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical wall panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical wall panels carefully to avoid chipping edges or damaged units in any way.

## 1.7 PROJECT CONDITIONS

- A. Space Enclosure:
  - 1. Soundsoak Fiberglass Panels: All wet work must be complete and dry prior to installation. Installation shall be carried out where the temperature is between 40 degrees F and 120 degrees F. These temperature condition must be maintained throughout the life of the warranty.

**1.8 WARRANTY**

- A. Acoustical Wall Panel: Submit a written warranty executed by the manufacturer, agreeing to repair and replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
  - 1. Acoustical Wall Panels: Manufacturer's defects.
- B. Warranty Period:
  - 1. Acoustical wall panels: One (1) year from date of substantial completion.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

**1.9 MAINTENANCE**

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match product installed. Packaged with protective covering for storage and identification with appropriate labels.
  - 1. Acoustical Wall Panels: Furnish quantity of full-size units equal to 5.0 percent of amount installed.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Acoustical Wall Panels:
  - 1. Armstrong World Industries, Inc.

**2.2 ACOUSTICAL WALL PANELS**

- A. Acoustical Wall Panels:
  - 1. Type AWP-1: Soundsoak Custom (Band Hall 126, Percussion 133 & 134)
  - 2. Type AWP-2: Soundsoak 85, Panels (Practices Rooms)
- B. Surface Texture: Fabric
  - 1. Composition: Fiberglass with resin-hardened edges.
  - 2. Fabric Finish: Architect to select from manufacturer's full range of fabrics.
  - 3. Fiberglass Thickness: 1 inch
  - 4. Sizes:
    - a. Type AWP-1: Up to 4 feet wide 12 feet tall or up to 5 feet wide 10 feet tall.
    - b. Type AWP-2: Panel width 24", Architect to select from full range of heights.

5. Edge Profile: Standard – Fabric wrapped (beveled) edges on two long panel sides.
6. Noise Reduction Coefficient (NRC): ASTM C 423; A Mounting: inch (0.80).
7. Flame Spread: ASTM E84; with FR-701 Fabrics – composite Class A rating.
8. Dimensional Stability: Standard – space must be enclosed with HVAC system operating at all time.
9. Acceptable Product: Soundsoak, as manufactured by Armstrong World Industries.

C. Acoustical Wall Panel Accessories: z-clips or Impaling clips.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

#### 3.2 PREPARATION

- A. Measure each wall area and establish layout of acoustical units to balance border widths at opposite edges of each wall. Coordinate panel layout with mechanical and electrical fixtures.

#### 3.3 INSTALLATION

- A. Install wall panels by attaching the panels to an existing wall per the manufacturer's instructions, LS-297301, and in accordance with the authorities having jurisdiction.
- B. For installation instructions with internal H spline, refer to installation instructions for standard Soundsoak, LA-295818.

#### 3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Routine maintenance of Soundsoak wall panels should consist of **frequent vacuuming** to minimize dirt accumulation. A dry or wet shampoo can be used on Soundsoak fabric. Work in with a damp sponge and vacuum to remove residue.

END OF SECTION

**SECTION 099123 - INTERIOR PAINTING**

**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 surface preparation and the application of paint systems on the following interior substrates:

- 1. Steel (including exposed sprinkler system piping in stairwells).
- 2. Galvanized metal.
- 3. Wood.
- 4. Gypsum board.
- 5. Concrete
- 6. All components of metal pan stairs, including underside of landings.

- B. Related Requirements:

- 1. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
- 2. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

**1.3 DEFINITIONS**

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 80 units at 60 degrees, according to ASTM D 523.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
  - 3. VOC content.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Behr Process Corporation.
  - 2. Benjamin Moore & Co.
  - 3. Coat of Silence Acoustical Paint Products
  - 4. Farrell-Calhoun.
  - 5. ICI Paints.
  - 6. Kelly-Moore Paints.
  - 7. Pratt & Lambert.
  - 8. Sherwin-Williams Company (The) – Basis of Design.
  
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

**2.2 PAINT, GENERAL**

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
  
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
  
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 1. Flat Paints and Coatings: 50 g/L.
  - 2. Nonflat Paints and Coatings: 150 g/L.
  - 3. Primers, Sealers, and Undercoaters: 200 g/L.
  - 4. Floor Coatings: 100 g/L.
  
- D. Colors: As selected by Architect from manufacturer's full range.

**2.3 BLOCK FILLERS****A. Block Filler, Latex, Interior/Exterior:**

1. Sherwin Williams: PrepRite Block Filler or equal.

**2.4 PRIMERS/SEALERS****A. Primer Sealer, Latex, Interior:**

1. Sherwin Williams: B28W02600 ProMar 200 Zero VOC Interior latex primer or equal.

**B. Primer, Latex, for Interior Wood:**

1. Sherwin Williams: B28W08111 Premium Wall & Wood Primer or equal

**C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint system indicated.****2.5 STEEL AND METAL PRIMERS****A. Primer, Acrylic, Quick Dry, for Metal:**

1. Sherwin Williams: B66-3100 Series; Pro-industrial, Pro Cryl Universal Acrylic Primer or equal.

**B. Primer, Galvanized, Acrylic:**

1. Sherwin Williams: B66-3100 Series; Pro-industrial, Pro Cryl Universal Acrylic Primer or equal.

**2.6 WATER-BASED PAINTS****A. Latex, Interior, (Gloss Level 3):**

1. Sherwin Williams: B20 Series, ProMar 200 Zero VOC, Interior latex eggshell sheen.

**B. Latex, Interior, Semi-Gloss (Gloss Level 4):**

1. Sherwin Williams: B31 Series, ProMar 200 Zero VOC, Interior latex semi-gloss sheen.

**C. Epoxy, Interior, (Gloss Level 3): MPI #151.**

1. Sherwin Williams; Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-shel K46 or equal.

**D. Acrylic Quick Dry for Metal (Semi gloss):**

1. Sherwin Williams: B66-600 Series; Pro Industrial, Zero VOC, acrylic semi-gloss.



## 2.7 FLOOR COATINGS

## A. Sealer, Water Based, for Concrete Floors:

1. Sherwin Williams: H&C Wet Look Water-Based, 100% Clear Acrylic Sealer.

## 2.8 SOURCE QUALITY CONTROL

## A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Concrete: 12 percent.
  2. Masonry (Clay and CMU): 12 percent.
  3. Wood: 15 percent.
  4. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- E. **Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.**
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
  1. Application of coating indicates acceptance of surfaces and conditions.

## 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. **Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.**
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
  - 1. SSPC-SP 3, "Power Tool Cleaning."
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

## 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
  2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
    - a. Uninsulated metal piping.
    - b. Uninsulated plastic piping.
    - c. Pipe hangers and supports.
    - d. Metal conduit.
    - e. Plastic conduit.
  2. Paint the following work where exposed in occupied spaces:
    - a. Uninsulated metal piping.
    - b. Uninsulated plastic piping.
    - c. Pipe hangers and supports.
    - d. Metal conduit.
    - e. Plastic conduit.
    - f. Other items as directed by Architect.
  3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

## 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

## 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
  - 1. Latex System:
    - a. Prime Coat: Primer sealer, latex, interior.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, (Gloss Level 3).
- B. Concrete Substrates, Traffic Surfaces:
  - 1. Concrete Sealer System:
    - a. Topcoat: Stain, interior, for concrete floors.
    - b. First Coat: Sealer, interior, for concrete floors.
- C. CMU Substrates:
  - 1. Latex System:
    - a. Block Filler: Block filler, latex, interior/exterior.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, eggshell and/or semi-gloss per architect's direction.

- D. Steel Substrates, including all exposed surfaces of metal pan stairs and railings and underside of landings and exposed sprinkler system piping in stairwells:
1. Acrylic over Acrylic Primer System:
    - a. Prime Coat: Primer, acrylic, quick dry, for metal.
    - b. Intermediate Coat: Acrylic, interior, matching topcoat.
    - c. Topcoat: Acrylic, interior, semi gloss.
- E. Wood Substrates: Including wood trim, architectural woodwork, doors, windows, wood-based panel products, glued-laminated construction, exposed joists, and exposed beams.
1. Latex System:
    - a. Prime Coat: Primer, latex, for interior wood.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, (Gloss Level 3).
- F. Gypsum Board Substrates:
1. Latex System:
    - a. Prime Coat: Primer sealer, latex, interior.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, eggshell and/or semi-gloss per architect's direction.
  2. Water-based Epoxy Coating System:
    - a. Prime Coat: Water-based epoxy (interior).
    - b. Intermediate Coat: Water-based epoxy (interior).
    - c. Topcoat: Water-based epoxy (interior).

END OF SECTION



**SECTION 099300 - STAINING AND TRANSPARENT FINISHING**

**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 surface preparation and application of wood finishes on the following substrates:
  - 1. Interior Substrates:
    - a. Dressed lumber (finish carpentry).
    - b. Existing wood doors
    - c. Existing wood trim
- B. Related Requirements:
  - 1. Section 099113 "Exterior Painting" for standard paint systems on exterior substrates.
  - 2. Section 099123 "Interior Painting" for stains on concrete floors.

**1.3 DEFINITIONS**

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.
  - 1. Submit Samples on representative samples of actual wood substrates, 8 inches square or 8 inches long.
  - 2. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.
3. VOC content.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. of each material and color applied.

**1.6 DELIVERY, STORAGE, AND HANDLING**

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

**1.7 FIELD CONDITIONS**

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. BLP Mobile Paint Manufacturing.
4. Farrell-Calhoun.
5. ICI Paints.



6. Kelly-Moore Paints.
7. PPG Architectural Finishes, Inc.
8. Pratt & Lambert.
9. Sherwin-Williams Company (The) – Basis of Design.

**2.2 MATERIALS, GENERAL**

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
  2. Stains: VOC not more than 250 g/L.
  3. Primers, Sealers, and Undercoaters: 200 g/L.
- D. Stain Colors: As selected by Architect from manufacturer's full range.

**2.3 WOOD FILLERS**

- A. Wood Filler Paste:
  1. Sherwin Williams C-86 Carpenter's Wood Filler or equal.

**2.4 PRIMERS AND SEALERS**

- A. Alkyd, Sanding Sealer, Clear:
  1. Sherwin Williams Wood Classics Fast Drying Sanding Sealer equal.

**2.5 STAINS**

- A. Stains, Semi-Transparent, for Interior Wood:
  1. Sherwin Williams Wood Classics Interior Wood Stain (A49 Series) or equal.

**2.6 POLYURETHANE VARNISHES**

- A. Varnish, Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4)
  - 1. Sherwin Williams products.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
  - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

**3.2 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
  - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.
  - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

## D. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

## 3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
1. Use applicators and techniques suited for finish and substrate indicated.
  2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
  3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

## 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

**3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE**

**A. Wood substrates, nontraffic surfaces, including wood trim.**

**1. Polyurethane Varnish System:**

- a. Prime Coat: Polyurethane varnish matching topcoat.**
- b. Intermediate Coat: Polyurethane varnish matching topcoat.**
- c. Topcoat: Varnish, interior, polyurethane, oil-modified, satin (Gloss Level 4).**

**END OF SECTION**

SECTION 101423 - PANEL SIGNAGE

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. Room-identification signs.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
  - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Room-Identification Signs: 6-inch x 6-inch Full-size Sample.

- E. Sign Schedule: Use same designations specified or in a sign schedule to be provided by the Architect prior to fabrication.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer.
- B. Sample Warranty: For special warranty.

**1.7 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For signs to include in maintenance manuals.

**1.8 FIELD CONDITIONS**

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

**1.9 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for signs.

## 2.2 SIGNS

- A. Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
1. Ace Sign Systems, Inc.
  2. Advance Corporation; Braille-Tac Division.
  3. ASI Sign Systems, Inc.
  4. Best Sign Systems Inc. (Basis-of-Design)
  5. InPro Corporation.
  6. Mohawk Sign Systems.
- B. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Basis-of-Design Product: Best Sign Systems, Inc. – HC300 ADA System.
  2. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: 0.25 inch.
    - b. Subsurface Graphics: Reverse etch image.
    - c. Color(s): As selected by Architect from manufacturer's full range.
    - d. ADA Sign: 6-inch x 8-inch pictogram.
    - e. Room Identification Sign: 6-inch x 6-inch.
  3. Sign-Panel Perimeter: Finish edges smooth.
    - a. Edge Condition: Square cut.
    - b. Corner Condition in Elevation: Rounded to Radius Indicated: 1 inch radius/  
no border.
  4. Frame: No Frame.
  5. Mounting: Countersunk flathead through fasteners.
  6. Text and Typeface: Accessible raised characters and Braille, typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
  7. Quantity: Provide a total of twenty-two (22) room identification signs, determined by existing doors at rooms with work in this project. Numbering and naming and symbols to be determined during shop drawing process.

## 2.3 PANEL-SIGN MATERIALS

- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.

**2.4 ACCESSORIES**

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    - b. Fastener Heads: For nonstructural connections, use oval countersunk screws and bolts with tamper-resistant, one-way-head slots unless otherwise indicated.

**2.5 FABRICATION**

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

**2.6 GENERAL FINISH REQUIREMENTS**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.



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

### 3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.
- C. Mounting Methods:
  - 1. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.

### 3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423



**SECTION 102800 - TOILET, BATH, AND LAUNDRY 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. Public-use washroom accessories.
  - 2. Custodial accessories.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Features that will be included for Project.
  - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify products using designations indicated.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Warranty: Sample of special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

**1.7 COORDINATION**

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

**1.8 WARRANTY**

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 15 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

**2.2 PUBLIC-USE WASHROOM ACCESSORIES**

- A. Manufacturers: Subject to compliance with requirements, or a comparable product by of the following:
- B. Soap Dispenser (SD): Provided and installed by General Contractor.
  - 1. DEB, Proline #91128.
    - a. Contractor to provide blocking.
- C. Paper Towel Dispenser (PTD): Provided and installed by General Contractor.
  - 1. Vondrehle, #6622 Center Pull.
    - a. Contractor to provide blocking.
- D. Toilet Tissue Dispenser (TTD): Provided and installed by General Contractor.
  - 1. Vondrehle tissue dispensers, # CT405, holds 4 rolls.
    - a. Contractor to provide blocking.

**2.3 FABRICATION**

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

**3.2 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

**END OF SECTION 102800**



**SECTION 105200 - FIRE PROTECTION SPECIALTIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply of this Section.

**1.2 SUMMARY**

- A. This Section includes:
  - 1. Fire extinguishers.
  - 2. Fire extinguisher cabinets.
  - 3. Mounting brackets.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified, include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

**1.4 QUALITY ASSURANCE**

- A. Single-Source Responsibility: Obtain fire extinguishers and cabinets from one source from a single manufacturer.
- B. UL-Listed Products: Fire extinguishers UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Products: Manufacturers that provide products complying with the following description and may be incorporated into the work include but are not limited to:
  - 1. J.L Industries
  - 2. Larsen's
  - 3. Strike First Corporation of America

**B. Basis of Design Product: Larsen's**

1. Fire Extinguisher: MP5-A
2. Fire Extinguisher Cabinet: "Architectural" Series SS FS-2409-R3
3. Mounting Bracket: 821

**2.2 FIRE EXTINGUISHERS**

**A. General:** Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard, which comply with requirements of governing authorities.

1. Abbreviations indicated below identify extinguisher types related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.
2. Install and space fire extinguishers in accordance with NFPA 10.

**B. Multipurpose Dry Chemical Type:** UL-rated 3A-40B:C, 10-lb. nominal capacity, in enameled steel container.

**2.3 MOUNTING BRACKETS**

**A. Provide brackets designed to prevent accidental dislodgment of extinguisher, of sizes required for type and capacity of extinguisher indicated in plated finish.**

1. Provide brackets for extinguishers not located in cabinets.

**2.4 FIRE EXTINGUISHER CABINETS**

**A. General:** Provide fire extinguisher cabinets where indicated, of suitable size for housing fire extinguishers of type and capacities indicated.

**B. Construction:** Manufacturer's standard enameled steel box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.

**C. Cabinet Type:** Suitable for mounting conditions indicated, of the following types:

1. Semi-recessed: Cabinet box (tub) partially recessed in walls of shallow depth.
2. Fire rated: U.L. approved cabinet for installation in fire rated partitions. Provide only for cabinets designated to be installed in a fire rated wall. All other cabinets can be standard type.

**D. Trim Style:** Fabricate trim in one piece with corners mitered, welded, and ground smooth.

1. Rolled-Edge Trim with 2-1/2 inch backbend depth.
2. Trim Metal: Of same metal and finish as door.



- E. Door Material and Construction: Manufacturer's standard door construction of material indicated, coordinated with cabinet types and trim styles selected.
  - 1. Stainless Steel: Manufacturer's standard door construction, fabricated from austenitic stainless-steel complying with ASTM A 167, for ISS Type 302/304 alloy.
  - 2. White door with horizontal black letters.
- F. Identify fire extinguisher in cabinet with black lettering spelling "FIRE EXTINGUISHER" applied to door. Provide lettering as selected by Architect from manufacturer's standard arrangements.
- G. Door Style: Manufacturer's standard design.
  - 1. Solid with safety-lock.
- H. Door Hardware: Provide door pull with cam lock-based design that permits access during an emergency by sharply pulling on the door pull yet prevents vandalism associated with standard pull handle. Provide concealed or continuous-type hinge permitting door to open 180 deg.

## 2.5 FINISHES FOR FIRE EXTINGUISHER CABINETS, GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by application of strippable, temporary protective covering prior to shipment.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
  - 1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
  - 2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions. Fire extinguishers, if not indicated, locate as directed by Architect.
  - 3. Mounting height: Mount cabinet so that bottom edge of cabinet trim is at 42" AFF.

END OF SECTION



**INDEX OF MECHANICAL SPECIFICATIONS**

**ISSUE DATE: AUGUST 2021**

**PLUMBING**

220515	BASIC PLUMBING MATERIALS AND METHODS
220519	METERS AND GAGES FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220719	PLUMBING PIPING INSULATION
221116	DOMESTIC WATER PIPING
221316	SANITARY WASTE AND VENT PIPING
224213	COMMERCIAL WATER CLOSETS
224700	PLUMBING SPECIALTIES

**HEATING VENTILATION AND AIR CONDITIONING**

230515	BASIC HVAC MATERIALS AND METHODS
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230713	DUCT INSULATION
230719	HVAC PIPING INSULATION
230800	COMMISSIONING OF HVAC
230930	AIRFLOW SENSORS AND TRANSMITTERS
232300	REFRIGERANT PIPING
233113	METAL DUCTS
233300	DUCT ACCESSORIES
233423	HVAC POWER VENTILATORS
233713	DIFFUSERS, REGISTERS, AND GRILLES
234100	PARTICULATE AIR FILTRATION
238127	DUCTLESS SPLIT-SYSTEM AIR-CONDITIONING UNITS



**SECTION 220515 - BASIC PLUMBING 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 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Mechanical demolition.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

**1.3 DEFINITIONS**

- A. **Finished Spaces:** Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. **Exposed, Interior Installations:** Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. **Exposed, Exterior Installations:** Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. **Concealed, Interior Installations:** Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. **Concealed, Exterior Installations:** Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

**2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

**2.3 JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

#### 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - 1. Available Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Available Manufacturers:
    - a. Eslon Thermoplastics.



- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Available Manufacturers:
    - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
1. Available Manufacturers:
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
1. Available Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## 2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Available Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Carbon steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Under-deck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.8 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

## 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

- h. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
  - i. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
  - j. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 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. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten

bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Non-pressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install brass nipples and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install brass nipples and flanges to connect piping materials of dissimilar metals.
  - 5. Dielectric couplings and fittings shall NOT be used.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

### 3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### 3.9 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220515



**SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING**

**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 meters and gages for mechanical systems and water meters installed outside the building.
- B. Related Sections include the following:
  - 1. Mechanical equipment Sections that specify meters and gages as part of factory-fabricated equipment.
- C. Utility-Furnished Products: Water meters will be furnished to site, ready for installation.

**1.3 SUBMITTALS**

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.
- C. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.
- D. Shop Drawings: For brackets for duct-mounting thermometers.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- 1. Bimetal Dial Thermometers:
  - a. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
  - b. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
  - c. Ernst Gage Co.
  - d. Terice: H. O. Terice Co.

- e. Weiss Instruments, Inc.
- 2. Insertion Dial Thermometers:
  - a. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
  - b. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
  - c. Trerice: H. O. Trerice Co.
  - d. Weiss Instruments, Inc.
- 3. Pressure Gages:
  - a. AMETEK, Inc.; U.S. Gauge Div.
  - b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
  - c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
  - d. Ernst Gage Co.
  - e. Trerice: H. O. Trerice Co.
  - f. Weiss Instruments, Inc.
- 4. Test Plugs:
  - a. Flow Design, Inc.
  - b. MG Piping Products Co.
  - c. National Meter.
  - d. Peterson Equipment Co., Inc.
  - e. Sisco Manufacturing Co.
  - f. Trerice: H. O. Trerice Co.
  - g. Watts Industries, Inc.; Water Products Div.

## 2.2 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed are as follows:
  - 1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
  - 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

## 2.3 BIMETAL DIAL THERMOMETERS

- A. Description: ASME B40.3; direct-mounting, universal-angle dial type.
- B. Case: Stainless steel with 5-inch- diameter, glass lens.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Element: Bimetal coil.

- E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
- F. Stem: Stainless steel for separable socket, of length to suit installation.

**2.4 INSERTION DIAL THERMOMETERS**

- A. Description: ASME B40.3, bimetal type.
- B. Dial: 1-inch diameter.
- C. Case: Stainless steel.
- D. Stem: Dustproof and leakproof 1/8-inch- diameter, tapered-end stem with nominal length of 5 inches.

**2.5 SEPARABLE SOCKETS**

- A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
  - 1. Material: Brass, for use in copper piping.
  - 2. Material: Stainless steel, for use in steel piping.
  - 3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
  - 4. Insertion Length: To extend to one-third of diameter of pipe.
  - 5. Cap: Threaded, with chain permanently fastened to socket.
  - 6. Heat-Transfer Fluid: Oil or graphite.

**2.6 THERMOMETER WELLS**

- A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
  - 1. Material: Brass, for use in copper piping.
  - 2. Material: Stainless steel, for use in steel piping.
  - 3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
  - 4. Insertion Length: To extend to one-third of diameter of pipe.
  - 5. Cap: Threaded, with chain permanently fastened to socket.
  - 6. Heat-Transfer Fluid: Oil or graphite.

## 2.7 DUCT THERMOMETER SUPPORT FLANGES

- A. Description: Flanged-fitting bracket for mounting in hole of duct, with threaded end for attaching thermometer.
  - 1. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of exterior insulation.
  - 2. Insertion-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation lining.

## 2.8 PRESSURE GAGES

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- diameter, glass lens.
- C. Connector: Brass, NPS 1/4.
- D. Scale: White-coated aluminum with permanently etched markings.
- E. Accuracy: Grade B, plus or minus 2 percent of middle 50 percent of scale.
- F. Range: Comply with the following:
  - 1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
  - 2. Fluids under Pressure: Two times the operating pressure.

## 2.9 PRESSURE-GAGE FITTINGS

- A. Valves: NPS 1/4 brass or stainless-steel needle type.
- B. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
- C. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

## 2.10 TEST PLUGS

- A. Description: Nickel-plated, brass-body test plug in NPS 1/2 fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 psig minimum.

- D. Core Inserts: Two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gage.
- E. Core Material for Air, Water, Oil, and Gas: 20 to 200 deg F, chlorosulfonated polyethylene synthetic rubber.
- F. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.
- G. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.
  - 1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

**PART 3 - EXECUTION**

**3.1 METER AND GAGE INSTALLATION, GENERAL**

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

**3.2 THERMOMETER INSTALLATION**

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic coil in air-handling units.
  - 3. Inlet and outlet of each hydronic heat exchanger.
  - 4. Each duct thermometer support flange.
- C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
  - 1. Install with socket extending to one-third of diameter of pipe.
  - 2. Fill sockets with oil or graphite and secure caps.
- D. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
  - 1. Install with stem extending to one-third of diameter of pipe.
  - 2. Fill wells with oil or graphite and secure caps.
- E. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

### 3.3 PRESSURE-GAGE INSTALLATION

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install dry-type pressure gages in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Building water-service entrance.
  - 3. Chilled-water inlets and outlets of building..
- C. Install liquid-filled-type pressure gages at suction and discharge of each pump.
- D. Install pressure-gage needle valve and snubber in piping to pressure gages.
  - 1. Exception: Install syphon instead of snubber in piping to steam pressure gages.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
  - 1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.
  - 2. Connect flowmeter transmitters to meters.
- B. Make electrical connections to power supply and electrically operated meters and devices.
- C. Ground electrically operated meters.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Install electrical connections for power and devices.
- E. Electrical power, wiring, and connections are specified in Division 26 Sections.

3.5 ADJUSTING AND CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 220519





**SECTION 220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING**

**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 the following general-duty valves:
  - 1. Copper-alloy ball valves.
  - 2. Ferrous-alloy butterfly valves.
  - 3. Bronze check valves.
  - 4. Gray-iron swing check valves.
  - 5. Cast-iron plug valves.
- B. Related Sections include the following:
  - 1. Division 22 Section "HVAC Instrumentation and Controls" for control valves and actuators.
  - 2. Division 22 piping Sections for specialty valves applicable to those Sections only.

**1.3 DEFINITIONS**

- A. The following are standard abbreviations for valves:
  - 1. CWP: Cold working pressure.
  - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 3. NBR: Acrylonitrile-butadiene rubber.
  - 4. PTFE: Polytetrafluoroethylene plastic.
  - 5. SWP: Steam working pressure.

**1.4 SUBMITTALS**

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

**1.5 QUALITY ASSURANCE**

- A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
  - 1. Exceptions: Domestic hot- and cold-water, sanitary waste, and storm drainage piping valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

## 2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
  - 1. Handwheel: For valves other than quarter-turn types.
  - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
  - 3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- G. Extended Valve Stems: On insulated valves.
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
  - 1. Solder Joint: With sockets according to ASME B16.18.
    - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
  - 2. Threaded: With threads according to ASME B1.20.1.
- I. Valve Bypass and Drain Connections: MSS SP-45.

## 2.3 COPPER-ALLOY BALL VALVES

- A. Manufacturers:
  - 1. Two-Piece, Copper-Alloy Ball Valves:
    - a. Conbraco Industries, Inc.; Apollo Div.
    - b. Crane Co.; Crane Valve Group; Crane Valves.
    - c. Crane Co.; Crane Valve Group; Jenkins Valves.
    - d. Crane Co.; Crane Valve Group; Stockham Div.
    - e. Grinnell Corporation.
    - f. Hammond Valve.
    - g. Milwaukee Valve Company.

- h. NIBCO INC.
- i. Red-White Valve Corp.
- j. Watts Industries, Inc.; Water Products Div.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

## 2.4 FERROUS-ALLOY BUTTERFLY VALVES

A. Manufacturers:

- 1. Crane Co.; Crane Valve Group; Center Line.
- 2. Crane Co.; Crane Valve Group; Stockham Div.
- 3. General Signal; DeZurik Unit.
- 4. Grinnell Corporation.
- 5. Hammond Valve.
- 6. Metraflex Co.
- 7. Milwaukee Valve Company.
- 8. Mueller Steam Specialty.
- 9. NIBCO INC.
- 10. Red-White Valve Corp.
- 11. Watts Industries, Inc.; Water Products Div.

B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

C. Flangeless, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one or two piece stem.

D. Single-Flange, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one- or two-piece stem.

E. Flanged, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one or two piece stem.

## 2.5 BRONZE CHECK VALVES

A. Manufacturers:

- 1. Type 3, Bronze, Swing Check Valves with Metal Disc:
  - a. Cincinnati Valve Co.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Div.
  - e. Grinnell Corporation.
  - f. Hammond Valve.
  - g. Milwaukee Valve Company.

- h. NIBCO INC.
- i. Red-White Valve Corp.
- j. Watts Industries, Inc.; Water Products Div.

- B. Type 1, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with bronze disc and seat.
- C. Type 1, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with bronze disc and seat.

**2.6 GRAY-IRON SWING CHECK VALVES**

- A. Manufacturers:
  - 1. Cincinnati Valve Co
  - 2. Crane Co.; Crane Valve Group; Crane Valves.
  - 3. Crane Co.; Crane Valve Group; Jenkins Valves.
  - 4. Crane Co.; Crane Valve Group; Stockham Div.
  - 5. Grinnell Corporation.
  - 6. Hammond Valve.
  - 7. Milwaukee Valve Company.
  - 8. Mueller Co.
  - 9. NIBCO INC.
  - 10. Red-White Valve Corp.
  - 11. Watts Industries, Inc.; Water Products Div.
- B. Type I, Class 250, gray-iron, swing check valves with metal seats.

**2.7 CAST-IRON PLUG VALVES**

- A. Manufacturers:
  - 1. Non-lubricated-Type, Cast-Iron Plug Valves:
    - a. General Signal; DeZurik Unit.
    - b. Grinnell Corporation.
    - c. Mueller Flow Technologies.
    - d. Wheatley Gaso, Inc.
- B. Class 125 or 150, non-lubricated-type, cast-iron plug valves.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
  1. Shutoff Service: Ball, butterfly or gate valves. Use ball on 3" and smaller.
  2. Throttling Service: Ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same with higher SWP class or CWP ratings may be substituted.
- C. Domestic Water Piping: Use the following types of valves:
  1. Ball Valves, NPS 2 and Smaller Two piece, 400-psig CWP rating, copper alloy.
  2. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
  3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125 bronze.
  4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125 gray iron.

### 3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523



**SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**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 hangers and supports for mechanical system piping and equipment.
- B. Related Sections include the following:
  - 1. Division 22 Section "Plumbing piping Insulation" for insulation.

**1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

**1.4 PERFORMANCE REQUIREMENTS**

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

**1.5 SUBMITTALS**

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.
- C. Welding Certificates: Copies of certificates for welding procedures and operators.

1.6

## 1.7 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.
- C. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.
  - 1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Pipe Hangers:
    - a. AAA Technology and Specialties Co., Inc.
    - b. B-Line Systems, Inc.
    - c. Carpenter & Patterson, Inc.
    - d. Empire Tool & Manufacturing Co., Inc.
    - e. Globe Pipe Hanger Products, Inc.
    - f. Grinnell Corp.
    - g. GS Metals Corp.
    - h. Michigan Hanger Co., Inc.
    - i. National Pipe Hanger Corp.
    - j. PHD Manufacturing, Inc.
    - k. PHS Industries, Inc.
    - l. Piping Technology & Products, Inc.
  - 2. Channel Support Systems:
    - a. B-Line Systems, Inc.
    - b. Grinnell Corp.; Power-Strut Unit.

- c. GS Metals Corp.
  - d. Michigan Hanger Co., Inc.; O-Strut Div.
  - e. National Pipe Hanger Corp.
  - f. Thomas & Betts Corp.
  - g. Unistrut Corp.
  - h. Wesanco, Inc.
3. Thermal-Hanger Shield Inserts:
- a. Carpenter & Patterson, Inc.
  - b. Michigan Hanger Co., Inc.
  - c. PHS Industries, Inc.
  - d. Pipe Shields, Inc.
  - e. Rilco Manufacturing Co., Inc.
  - f. Value Engineered Products, Inc.
4. Powder-Actuated Fastener Systems:
- a. Gunnebo Fastening Corp.
  - b. Hilti, Inc.
  - c. ITW Ramset/Red Head.
  - d. Masterset Fastening Systems, Inc.

## 2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
- 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
- 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
  - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi (690-kPa) minimum compressive-strength insulation, encased in sheet metal shield.
- 1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
  - 2. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
  - 3. Material for Cold Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.

4. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
5. Material for Hot Piping: ASTM C 552, Type I cellular glass.
6. Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate.
7. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
8. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
9. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

### 2.3 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 A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.
  3. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
  1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
  7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate

or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.



- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- E. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- K. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.9.
  - 2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 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 make smooth bearing surface.

### 3.4 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.

### 3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: 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. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529



**SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

**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 the following mechanical identification materials and their installation:
  - 1. Equipment nameplates.
  - 2. Access panel and door markers.
  - 3. Pipe markers.
  - 4. Stencils.
  - 5. Warning tags.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.

**1.4 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.

**1.5 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 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  2. Location: Accessible and visible.
  3. Fasteners: As required to mount on equipment.
- B. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

## 2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
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 strip-type pipe markers at least three times letter height and of length required for label.
  5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without 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. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
  - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
  - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

**2.3 STENCILS**

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
  - 1. Stencil Material: Metal or fiberboard.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

**2.4 WARNING TAGS**

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
  - 4. Color: Yellow background with black lettering.

**PART 3 - EXECUTION**

**3.1 APPLICATIONS, GENERAL**

- A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

## 3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
1. Water heaters.
  2. Hot water recirculating pumps.

## 3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pre-tensioned pipe markers. Use size to ensure a tight fit.
  2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
  3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
  4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers with painted, color-coded bands or rectangles complying with ASME A13.1 on each piping system.
1. Identification Paint: Use for contrasting background.
  2. Stencil Paint: Use for pipe marking.
- C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.



7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

**3.4 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**3.5 ADJUSTING**

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

**3.6 CLEANING**

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

**END OF SECTION 220553**



**SECTION 220719 – PLUMBING PIPING INSULATION**

**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 preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 22 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

**1.3 SUBMITTALS**

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 3. Removable insulation at piping specialties and equipment connections.
  - 4. Application of field-applied jackets.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

**1.5 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment".
- B. Coordinate clearance requirements with piping Installer for insulation application.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.
  - 2. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.

**2.2 INSULATION MATERIALS**

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
  - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
  - 2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
  - 3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
    - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
    - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
  - 4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
  - 5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
  - 6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
  - 7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.
  2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- C. Calcium Silicate Insulation: Preformed pipe sections of noncombustible, inorganic, hydrous calcium silicate with a nonasbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- D. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

### 2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
1. Adhesive: As recommended by insulation material manufacturer.
  2. PVC Jacket Color: White or gray.
  3. PVC Jacket Color: Color-code piping jackets based on materials contained within the piping system.
- D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
  2. Adhesive: As recommended by insulation material manufacturer.
- E. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: 0.010 inch thick.
  2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- F. Stainless-Steel Jacket: ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.
1. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
  3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

### 2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
  - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
  - 2. Aluminum: 0.007 inch thick.

## 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

- P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."
- S. Floor Penetrations: Apply insulation continuously through floor assembly.
  - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

### 3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
  - 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
  - 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
  - 1. Apply preformed pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  - 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
  - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  - 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
  - 3. Cover fittings with standard PVC fitting covers, when fittings are above 7'0" AFF.



4. Cover fittings with heavy PVC fitting cover, when fittings are below 7'0" AFF. 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.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

### 3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. 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.

### 3.6 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.

1. Draw jacket material smooth and tight.
2. Apply lap or joint strips with the same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

C. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

D. Apply metal jacket where indicated, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.7 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating to piping insulation located outdoors.

### 3.8 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Below-grade piping, unless otherwise indicated.
4. Chrome-plated pipes and fittings, unless potential for personnel injury.
5. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

## 3.9 FIELD QUALITY CONTROL

- A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
1. Inspect fittings and valves randomly selected by Architect.
  2. Remove fitting covers from 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.
  3. Remove fitting covers from 20 valves or 1 percent of valves, whichever is less, for various pipe sizes.
- B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.
- C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

## 3.10 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

## 3.11 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and re-circulated hot water (Mains).
1. Operating Temperature: 60 to 140 deg F.
  2. Insulation Material: Mineral fiber.
  3. Insulation Thickness: 1".
  4. Jacket: Foil and paper.
  5. Vapor Retarder Required: No.
- B. Service: Domestic hot water (Branch piping).
1. Operating Temperature: 60 to 140 deg F.
  2. Insulation Material: Mineral fiber.
  3. Insulation Thickness: ½".
  4. Jacket: Foil and paper.
  5. Vapor Retarder Required: No.

C. Service: Domestic cold water.

1. Operating Temperature: 35 to 60 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Copper Pipe: 2" and below, ½" thick.
  - b. Copper Pipe: above 2", 1" thick.
  - c. Piping in exterior walls: All sizes: 1" thick.
4. Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

D. Service: Air conditioning condensate drain piping.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: ¾"
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.

END OF SECTION 220719

**SECTION 221116 - DOMESTIC WATER PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.
- B. See Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and fittings.

**1.2 SUBMITTALS**

- A. Water Samples: Specified in "Cleaning" Article in Part 3.
- B. Field quality-control test reports.

**1.3 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

**PART 2 - PRODUCTS**

**2.1 PIPING MATERIALS**

- A. Transition Couplings: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
  - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- C. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

## 2.2 VALVES

- A. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for bronze and cast-iron, general-duty valves.
- B. Refer to Division 22 Section "Plumbing Specialties" for balancing and drain valves.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Domestic Water Piping: Use the following piping materials for each size range:
  1. NPS 4 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

### 3.2 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.

### 3.3 PIPING INSTALLATION

- A. Refer to Division 15 Section "Basic Plumbing Materials and Methods" for basic piping installation.
- B. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.

- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages, and to Division 22 Section "Plumbing Specialties" for drain valves and strainers.
- D. Install domestic water piping level and plumb.
- E. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- F. Perform the following steps 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. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
  - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  - 6. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- G. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- H. Check plumbing specialties and verify proper settings, adjustments, and operation.
  - 1. Water-Pressure Regulators: Set outlet pressure at 60 psig maximum, unless otherwise indicated.
- I. Energize pumps and verify proper operation.

**3.4 JOINT CONSTRUCTION**

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

**3.5 VALVE INSTALLATION**

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

- C. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
  - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
  - 2. Install stop-and-waste drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Refer to Division 15 Section "Plumbing Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Refer to Division 15 Section "Plumbing Specialties" for calibrated balancing valves.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 15 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 thru NPS 4 : 96 inches with 3/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.7 CONNECTIONS



- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow 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 service piping with shutoff valve, and extend and connect to the following:
  - 1. Booster Systems: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
  - 4. 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.

### 3.8 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
  - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
  - 2. 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:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping in accordance with all requirements of authority having jurisdiction, including any adopted federal, state or local regulations and amendments. In the absence of any state or local requirements test as follows:
  - 1. 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 separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

**3.9 CLEANING**

**A. Clean and disinfect potable domestic water piping as follows:**

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

**B. Prepare and submit reports of purging and disinfecting activities.**

**C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.**

END OF SECTION 221116

**SECTION 221316 - SANITARY WASTE AND VENT PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes soil and waste, sanitary drainage and vent piping inside the building.

**1.2 SUBMITTALS**

- A. Field quality-control test reports.

**1.3 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

**PART 2 - PRODUCTS**

**2.1 PIPING MATERIALS**

- A. Flexible Transition Couplings for Underground Non-pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.
- B. PVC Pipe: ASTM D 2665, Schedule 40, solid-wall drain, waste and vent (DWV).
  - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- C. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
  - 1. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
    - a. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.
      - 1) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
      - 2) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.
- D. Steel Pipe: ASTM A 53, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Cast-Iron, Threaded, Drainage Fittings: ASME B16.12, galvanized.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Soil, Waste, and Vent Piping, above and below grade and piping not installed in environmental plenums: Use the following piping materials for each size range:
  1. NPS 1-1/4 and NPS 6: PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, Soil, Waste, and Vent Piping exposed to view or installed in environmental plenum: Use any of the following piping materials for each size range:
  1. NPS 1-1/4 and NPS 1-1/2 (DN 32 and DN 40): Use NPS 1-1/2 (DN 40) hubless, cast-iron soil piping and one of the following:
    - a. Couplings: Heavy-duty, Type 304, stainless steel.
  2. NPS 1-1/4 and NPS 1-1/2 (DN 32 and DN 40): Galvanized steel pipe; cast-iron, threaded drainage fittings; and threaded joints.
  3. NPS 2 to NPS 6 (DN 50 to DN 150): Hubless, cast-iron soil piping and one of the following:
    - a. Couplings: Heavy-duty, Type 304, stainless steel.

### 3.2 PIPING INSTALLATION

- A. Refer to Division 15 Section "Basic Plumbing Materials and Methods" for basic piping installation.
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and

reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- D. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- E. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Horizontal Sanitary Building Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- F. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- G. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.3 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Plumbing Materials and Methods" for basic piping joint construction.
- B. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment".
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- D. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  - 2. NPS 3: 48 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  - 4. NPS 6: 48 inches with 3/4-inch rod.
- E. Install supports for vertical PVC piping every 48 inches.

- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.5 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

### 3.6 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 drainage and vent piping in accordance with all requirements of authority having jurisdiction, including any adopted federal, state or local regulations and amendments. In the absence of any state or local requirements test as follows:
  - 1. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 2. Prepare reports for tests and required corrective action.

### 3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains 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.

**3.8 PROTECTION**

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of compatible water-based latex paint matching adjacent roof color.

**END OF SECTION 221316**





**SECTION 224213 – COMMERCIAL WATER CLOSETS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes plumbing fixtures and related components.

**1.2 DEFINITIONS**

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

**1.3 SUBMITTALS**

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- B. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and maintenance data.

**1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. 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"; about plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- 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. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
  2. Hand Sinks: NSF 2 construction.
  3. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  4. Vitreous-China Fixtures: ASME A112.19.2M.
  5. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
  6. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and 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. Hose-Connection Vacuum Breakers: ASSE 1011.
  5. Hose-Coupling Threads: ASME B1.20.7.
  6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  7. NSF Materials: NSF 61.
  8. Pipe Threads: ASME B1.20.1.
  9. Supply and Drain Fittings: ASME A112.18.1M.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
  2. Brass and Copper Supplies: ASME A112.18.1M.
  3. Manual-Operation Flushometers: ASSE 1037.
  4. Plastic Tubular Fittings and Piping: ASTM F 409.
  5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
  6. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Floor Drains: ASME A112.21.1M.
  2. Hose-Coupling Threads: ASME B1.20.7.
  3. Off-Floor Fixture Supports: ASME A112.6.1M.
  4. Pipe Threads: ASME B1.20.1.
  5. Plastic Toilet Seats: ANSI Z124.5.
  6. Supply and Drain Protective Shielding Guards: ICC A117.1.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Available Manufactures:
    - a. Delta Faucet Company.
    - b. Elkay Manufacturing Company.
    - c. Jay R Smith Manufacturing Company.
    - d. Just Manufacturing Company.
    - e. Kohler Company.
    - f. Sloan Valve Company.

**2.2 PLUMBING FIXTURE SCHEDULE**

- A. Refer to the Plumbing Fixture Schedule on Sheet P001 for a description of each plumbing fixture or specialty item utilized on this project. Manufacturer and product number are representative of the type and quality of fixture to be furnished and installed.

**PART 3 - EXECUTION**

**3.1 FIXTURE INSTALLATION**

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- D. Install wall-hanging fixtures with tubular waste piping attached to supports.
- E. Install counter-mounting fixtures in and attached to casework.
- F. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

- G. 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.
  - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping".
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- J. Install toilet seats on water closets.
- K. 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.
- L. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- M. 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.
- N. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
- O. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Basic Plumbing Materials and Methods" for escutcheons.
- P. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

### 3.2 CONNECTIONS

- A. Connect water supplies from water distribution piping to fixtures.
- B. Connect drain piping from fixtures to drainage piping.

- C. 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.
- D. 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.

**3.3 PROTECTION**

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213



**SECTION 224700 - PLUMBING SPECIALTIES**

**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 the following plumbing specialties:
  - 1. Strainers.
  - 2. Frost proof hose bibbs.
  - 3. Drain valves.
  - 4. Miscellaneous piping specialties.
  - 5. Sleeve penetration systems.
  - 6. Flashing materials.
  - 7. Cleanouts.
  - 8. Floor drains.
- B. Related Sections include the following:
  - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for water meters, thermometers, and pressure gages.

**1.3 DEFINITIONS**

- A. The following are industry abbreviations for plastic piping materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. PE: Polyethylene plastic.
  - 3. PUR: Polyurethane plastic.
  - 4. PVC: Polyvinyl chloride plastic.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Domestic Water Piping: 125 psig.
  - 2. Sanitary Waste and Vent Piping: 10-foot head of water.
  - 3. Storm Drainage Piping: 10-foot head of water.
  - 4. Force-Main Piping: 100 psig.

## 1.5 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
1. Balancing valves, water filters, and strainers.
  2. Water hammer arresters, air vents, and trap seal primer valves and systems.
  3. Drain valves, hose bibbs, hydrants, and hose stations.
  4. Outlet boxes and washer-supply outlets.
  5. Backwater valves, cleanouts, floor drains, open receptors, trench drains, and roof drains.
  6. Air-admittance valves, vent caps, vent terminals, and roof flashing assemblies.
  7. Grease interceptors, grease recovery units, oil interceptors, and solids interceptors.
  8. Sleeve penetration systems.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field test reports.
- D. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
1. Backflow preventers and water regulators.
  2. Water filters.
  3. Thermostatic water mixing valves and water tempering valves.
  4. Trap seal primer valves and systems.
  5. Hose stations and hydrants.

## 1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. NSF Compliance:
1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
  2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.



**1.7 EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Operating Key Handles: Equal to 10 percent of amount installed for each key-operated hose bibb and hydrant installed.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

**2.2 STRAINERS**

A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch round perforations, unless otherwise indicated.

1. Pressure Rating: 125-psig minimum steam working pressure, unless otherwise indicated.
2. NPS 2 and Smaller: Bronze body, with female threaded ends.
3. NPS 2-1/2 and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
  - a. Drain: Factory- or field-installed, hose-end drain valve.
5. T-Pattern Strainers: Malleable-iron or ductile-iron body with grooved ends; access end cap with drain plug and access coupling with rubber gasket.

**2.3 FROST PROOF HOSE BIBBS**

A. Manufacturers:

1. Josam Co.
2. Smith, Jay R. Mfg. Co.
3. Watts Industries, Inc.; Drainage Products Div.
4. Woodford Manufacturing Co.
5. Zurn Industries, Inc.

B. General: ASME A112.21.3M, wheel handle operation hydrant with pressure rating of 125 psig.

1. Inlet: NPS 3/4 threaded or solder joint.
  2. Outlet: ASME B1.20.7, garden-hose threads.
  3. Operating Keys: One with each key-operation hydrant.
- C. Non-freeze Exposed-Outlet Wall Hydrants: ASSE 1019, self-drainable with integral non-removable hose-connection vacuum breaker, casing and operating rod to match wall thickness, projecting outlet, and wall clamp.
1. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
  2. Nozzle and Wall Plate Finish: Rough bronze.
- D. Non-freeze Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral non-removable hose-connection vacuum breaker, casing and operating rod to match wall thickness, concealed outlet, and wall clamp.
1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
  2. Box and Cover Finish: Rough bronze.
- E. Moderate-Climate, Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral non-removable hose-connection vacuum breaker, and concealed outlet.
1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
  2. Box and Cover Finish: Rough bronze.

**2.4 DRAIN VALVES**

- A. Hose-End Drain Valves: MSS SP-110, NPS 3/4 ball valve, rated for 400-psig minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
1. Inlet: Threaded or solder joint.
  2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.

**2.5 MISCELLANEOUS PIPING SPECIALTIES**

- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.
1. Available Manufacturers:
  2. Manufacturers:
    - a. Josam Co.
    - b. Smith, Jay R. Mfg. Co.
    - c. Tyler Pipe; Wade Div.

- d. Zurn Industries, Inc.; Specification Drainage Operation.
- B. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig ; integral nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
1. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
  2. Finish for Service Areas: Chrome or nickel plated.
  3. Finish for Finished Rooms: Chrome or nickel plated.
  4. Operation for Equipment Rooms: Wheel handle or operating key.
  5. Operation for Service Areas: Wheel handle.
  6. Operation for Finished Rooms: Operating key.
  7. Include operating key with each operating-key hose bibb.
  8. Include integral wall flange with each chrome- or nickel-plated hose bibb.
- C. Air-Admittance Valves: Plastic housing with mechanical-operation sealing diaphragm, designed to admit air into drainage and vent piping and to prevent transmission of sewer gas into building.
1. Manufacturers:
    - a. B & K Industries, Inc.
    - b. J & B Products.
    - c. Magic Vent Co., Inc.
    - d. Oatey.
    - e. Sioux Chief Manufacturing Co., Inc.
    - f. Studor, Inc.
  2. Stack Vent Valve: ASSE 1050, designed for installation as terminal on soil, waste, and vent stacks, instead of stack vent extending through roof, in NPS 2 to NPS 4.
  3. Fixture Vent Valve: ASSE 1051, designed for installation on waste piping, instead of vent connection, for single fixture, in NPS 1-1/4 to NPS 2.
- D. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.
1. NPS 2: 4-inch- minimum water seal.
  2. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- E. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- F. Stack Flashing Fittings: Counter-flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- G. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.

- H. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counter-flashing.
- I. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.

## 2.6 SLEEVE PENETRATION SYSTEMS

- A. Available Manufacturers:
- B. Manufacturers:
  - 1. ProSet Systems, Inc.
- C. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
  - 1. 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.
  - 2. Stack Fitting: ASTM A 48, gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
    - a. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

## 2.7 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Use: 4-lb/sq. ft., 0.0625-inch thickness.
  - 2. Vent Pipe Flashing: 3-lb/sq. ft., 0.0469-inch thickness.
  - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152, of the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Applications: 12 oz./sq. ft.
  - 2. Vent Pipe Flashing: 8 oz./sq. ft.
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.

- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Refer to Division 15 Section "Basic Plumbing Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- C. 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.
- D. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- E. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- F. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- G. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- H. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- I. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  4. Install individual trap guard/seals for floor drains connected to sanitary building drain, unless otherwise indicated.
- J. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- K. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- L. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- M. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty ball, butterfly, check, gate, and globe valves.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 22 Sections.
- D. Ground equipment.
- E. 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.
- F. Connect plumbing specialties and devices that require power according to Division 26 Sections.

### 3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft., 0.0625-inch thickness or thinner.
  2. Copper Sheets: Solder joints of copper sheets.

- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

**3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
  - 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 and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 224700





**SECTION 230515 - BASIC HVAC 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 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Mechanical demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

**1.3 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

**2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

**2.3 JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

#### 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - 1. Available Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Available Manufacturers:
    - a. Eslon Thermoplastics.

- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Available Manufacturers:
    - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  - 1. Available Manufacturers:
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  - 1. Available Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Available Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. EpcO Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Available Manufacturers:

- a. Capitol Manufacturing Co.
  - b. Central Plastics Company.
  - c. EpcO Sales, Inc.
  - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Available Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
1. Available Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
1. Available Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Available Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  1. Under-deck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  1. Finish: Polished chrome-plated
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.9 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:



- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
  - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
  - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
  - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
  - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
  - i. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
  - j. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
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. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
  - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Non-pressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

**3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

**3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

**3.9 GROUTING**

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230515



**SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**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 hangers and supports for mechanical system piping and equipment.
- B. Related Sections include the following:
  - 1. Division 23 Section "HVAC Piping Insulation" for insulation.

**1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

**1.4 PERFORMANCE REQUIREMENTS**

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

**1.5 SUBMITTALS**

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.
- C. Welding Certificates: Copies of certificates for welding procedures and operators.

**1.6 QUALITY ASSURANCE**

- A. **Welding:** Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. **Engineering Responsibility:** Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.
- C. **Engineering Responsibility:** Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.
  - 1. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - 1. **Pipe Hangers:**
    - a. AAA Technology and Specialties Co., Inc.
    - b. B-Line Systems, Inc.
    - c. Carpenter & Patterson, Inc.
    - d. Empire Tool & Manufacturing Co., Inc.
    - e. Globe Pipe Hanger Products, Inc.
    - f. Grinnell Corp.
    - g. GS Metals Corp.
    - h. Michigan Hanger Co., Inc.
    - i. National Pipe Hanger Corp.
    - j. PHD Manufacturing, Inc.
    - k. PHS Industries, Inc.
    - l. Piping Technology & Products, Inc.
  - 2. **Channel Support Systems:**
    - a. B-Line Systems, Inc.
    - b. Grinnell Corp.; Power-Strut Unit.
    - c. GS Metals Corp.



- d. Michigan Hanger Co., Inc.; O-Strut Div.
  - e. National Pipe Hanger Corp.
  - f. Thomas & Betts Corp.
  - g. Unistrut Corp.
  - h. Wesanco, Inc.
3. Thermal-Hanger Shield Inserts:
- a. Carpenter & Patterson, Inc.
  - b. Michigan Hanger Co., Inc.
  - c. PHS Industries, Inc.
  - d. Pipe Shields, Inc.
  - e. Rilco Manufacturing Co., Inc.
  - f. Value Engineered Products, Inc.
4. Powder-Actuated Fastener Systems:
- a. Gunnebo Fastening Corp.
  - b. Hilti, Inc.
  - c. ITW Ramset/Red Head.
  - d. Masterset Fastening Systems, Inc.

## 2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
  2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
  2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi (690-kPa) minimum compressive-strength insulation, encased in sheet metal shield.
1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
  2. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
  3. Material for Cold Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
  4. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
  5. Material for Hot Piping: ASTM C 552, Type I cellular glass.

6. Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate.
7. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
8. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
9. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

### 2.3 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 A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.
  3. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
  1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.

7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
  - a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
  1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
  1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- E. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- K. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.9.
  - 2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 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 make smooth bearing surface.

### 3.4 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.

### 3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

**3.6 PAINTING**

- A. Touching Up: 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. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529



**SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**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 the following mechanical identification materials and their installation:
  - 1. Equipment nameplates.
  - 2. Access panel and door markers.
  - 3. Pipe markers.
  - 4. Duct markers.
  - 5. Stencils.
  - 6. Warning tags.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.

**1.4 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.

**1.5 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 EQUIPMENT IDENTIFICATION DEVICES**

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
  - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

**2.2 PIPING IDENTIFICATION DEVICES**

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  - 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 strip-type pipe markers at least three times letter height and of length required for label.
  - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without 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. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
  - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
  - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

### 2.3 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

### 2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
  - 1. Stencil Material: Metal or fiberboard.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

### 2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
  - 4. Color: Yellow background with black lettering.

**PART 3 - EXECUTION**

**3.1 APPLICATIONS, GENERAL**

- A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

**3.2 EQUIPMENT IDENTIFICATION**

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
  - 1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
  - 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
  - 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
  - 4. Fans, blowers, primary balancing dampers, and mixing boxes.
  - 5. Packaged HVAC central-station, indoor air handlers, condensing units and zone-type units.

**3.3 PIPING IDENTIFICATION**

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
  - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pre-tensioned pipe markers. Use size to ensure a tight fit.
  - 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
  - 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
  - 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers with painted, color-coded bands or rectangles complying with ASME A13.1 on each piping system.

1. Identification Paint: Use for contrasting background.
  2. Stencil Paint: Use for pipe marking.
- C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

### 3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
1. Green: For cold-air supply ducts.
  2. Yellow: For hot-air supply ducts.
  3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
  5. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Stenciled Duct Marker Option: Stenciled markers, showing service and direction of flow, may be provided instead of laminated-plastic duct markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.6 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.7 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

## 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 testing, adjusting, and balancing of HVAC systems to produce design objectives. The TAB Agent shall be retained by the Owner. This Specification Section includes work to be performed by the TAB Agent and identifies the task to be performed by the Mechanical Contractor. The Mechanical Contractor shall cooperate with the Owner's TAB Agent and provide assistance as necessary to complete all aspects of the TAB work. The Mechanical Contractor shall provide the temporary provisions necessary for all ductwork leakage test required in Specification Section 15815 – "Metal Ducts" and shall coordinate with the Owner's TAB Agent in scheduling all required tests.
- B. The Mechanical Contractor shall include in the base bid an allowance of \$4,000.00 (Four Thousand Dollars) for the Owner's TAB agent to witness the air duct leakage tests and perform final testing, adjusting and balancing of the HVAC systems.**
- C. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
  - 1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
  - 2. Adjusting total HVAC systems to provide indicated quantities.
  - 3. Measuring electrical performance of HVAC equipment.
  - 4. Setting quantitative performance of HVAC equipment.
  - 5. Verifying that automatic control devices are functioning properly.
  - 6. Reporting results of the activities and procedures specified in this Section.
- D. Related Sections include the following:
  - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
  - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

## 1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. NEBB: National Environmental Balancing Bureau.
- P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

## 1.4 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing,



adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

- B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
- C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.
- D. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- E. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.
- F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

#### 1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
- C. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- D. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

#### 1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

#### 1.7 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the

Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

**PART 2 - PRODUCTS (Not Applicable)****PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
  - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in Division 1 Section "Project Record Documents."
- D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

- J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine equipment for installation and for properly operating safety interlocks and controls.
- Q. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices operate by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in variable-air-volume terminals.
  - 4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 5. Sensors are located to sense only the intended conditions.
  - 6. Sequence of operation for control modes is according to the Contract Documents.
  - 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
  - 8. Interlocked systems are operating.
  - 9. Changeover from heating to cooling mode occurs according to design values.
- R. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

### 3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Isolating and balancing valves are open and control valves are operational.

6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so design conditions for system operations can be met.
8. Clean filters of the correct size and type have been installed.

### 3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in national standards and this Section.
- B. 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 the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

### 3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.

### 3.5 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating if high-efficiency motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

### 3.6 HEAT-TRANSFER COILS

- A. Evaporator Coils. Measure the following data for each:

1. Dry-bulb temperatures of entering and leaving air.
2. Wet-bulb temperatures of entering and leaving air.
3. Airflow.
4. Air pressure drop.

### 3.7 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### 3.8 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.

- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.9 TOLERANCES

- A. Set HVAC system airflow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans: 0 to plus 5 percent.
  - 2. Air Outlets and Inlets: 0 to minus 10 percent.

### 3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.11 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data of all reviews, equipment, devices, etc., include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

3.12 ADDITIONAL TESTS

- A. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593





**SECTION 230713 - DUCT INSULATION**

**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 semi-rigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 23 Section "Pipe Insulation" for insulation for piping systems.
  - 2. Division 23 Section "Metal Ducts".

**1.3 SUBMITTALS**

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Removable insulation sections at access panels.
  - 2. Application of field-applied jackets.
  - 3. Applications at linkages for control devices.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
- D. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

**1.4 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

**1.6 COORDINATION**

- A. Coordinate clearance requirements with duct Installer for insulation application.

**1.7 SCHEDULING**

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.

**2.2 INSULATION MATERIALS**

- A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- C. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating.

- D. Field-Applied Jackets: ASTM C 921, Type 1, unless otherwise indicated.
  - 1. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
  - 2. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

**2.3 ACCESSORIES AND ATTACHMENTS**

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
  - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
  - 2. Aluminum: 0.007 inch thick.
- C. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
  - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- D. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
  - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface.
- E. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

**2.4 VAPOR RETARDERS**

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.

2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
  3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
  2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
  3. Seal insulation to roof flashing with vapor-retarder mastic.
- O. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- P. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- Q. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

### 3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.

4. Impale insulation over anchors and attach speed washers.
5. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
8. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round duct elbows with individually mitered gores cut to fit the elbow.
9. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

### 3.5 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Painting."

### 3.6 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:
  1. Indoor concealed supply, return, exhaust and outside-air ductwork.
  2. Indoor exposed supply, return, exhaust and outside-air ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  1. Factory-insulated flexible ducts.
  2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
  3. Flexible connectors.
  4. Vibration-control devices.
  5. Testing agency labels and stamps.
  6. Nameplates and data plates.
  7. Access panels and doors in air-distribution systems.

**3.8 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE**

- A. Service: Round and rectangular, supply-air, return-air, exhaust-air (to ERV) and outside-air ducts (where located within non-air conditioned mechanical room or attic).
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 3.0 inches.
  - 3. Density: 0.75 pcf
  - 4. Installed R-Value: 8.3
  - 5. Number of Layers: One.
  - 6. Factory-Applied Facing: Scrim-reinforced, foil-kraft paper and vinyl film (FSK).
  - 7. Vapor Retarder Required: Yes.

END OF SECTION 230713





**SECTION 230719 – HVAC PIPING INSULATION**

**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 preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 23 Section "Duct Insulation" for insulation for ducts and plenums.
  - 2. Division 23 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

**1.3 SUBMITTALS**

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 3. Removable insulation at piping specialties and equipment connections.
  - 4. Application of field-applied jackets.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

**1.5 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.

**2.2 INSULATION MATERIALS**

- A. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Adhesive: As recommended by insulation material manufacturer.
  - 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- B. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

**2.3 VAPOR RETARDERS**

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

**3.3 GENERAL APPLICATION REQUIREMENTS**

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
  3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."
- S. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.
- 3.4 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION
- A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
  2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to flanges as follows:
1. Apply pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.

2. 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.

### 3.5 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating to piping insulation located outdoors.

### 3.6 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  1. Flexible connectors.
  2. Vibration-control devices.
  3. Below-grade piping, unless otherwise indicated.
  4. Chrome-plated pipes and fittings, unless potential for personnel injury.
  5. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

### 3.7 FIELD QUALITY CONTROL

- A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
  1. Inspect fittings and valves randomly selected by Architect.
  2. Remove fitting covers from 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.
  3. Remove fitting covers from 20 valves or 1 percent of valves, whichever is less, for various pipe sizes.
- B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.
- C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

### 3.8 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

**3.9 INTERIOR INSULATION APPLICATION SCHEDULE**

A. Service: Air conditioning condensate drain piping and refrigerant (suction line) piping.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness:  $\frac{3}{4}$ "
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.
6. Finishes: See part 3.5 above.

END OF SECTION 230719

SECTION 230800 – COMMISSIONING OF HVAC

The HVAC and Plumbing contractors SHALL submit the attached form one (1) week prior to the need of a substantial completion review by Corbett Legge and Associates.

**ITEMS NEEDED FOR SUBSTANTIAL COMPLETION OBSERVATION  
BY ENGINEER**

<b>PROJECT:</b>		<b>FIELD REPORT NO:</b> Ready for Substantial Completion	
<b>CLIENT PROJECT NO:</b>		<b>CLA PROJECT NO:</b>	
<b>DATE:</b>	<b>TIME:</b> N/A	<b>WEATHER:</b> N/A	<b>TEMP RANGE:</b> N/A
<b>SUBMIT TO:</b> Eric Blake, (CLA Construction Administration)			
<p>The following items <b>MUST</b> be completed and ALL reports back to the engineer one week prior to scheduling Substantial Completion site observation.</p> <p><b>MECHANICAL, PLUMBING &amp; ELECTRICAL ITEMS:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 1. The MP&amp;E contractors <b>MUST</b> submit his job site inspection report listing all items found defective. Each of these items <b>MUST</b> be marked <b>COMPLETED</b> along with the signature and date of the person completing each item. _____ <b>Completed</b></li> <li><input type="checkbox"/> 2. Test and Balance must be completed and report submitted to engineer prior to scheduling Substantial Completion site observation . _____ <b>Completed</b></li> <li><input type="checkbox"/> 3. All prior Field Observation Reports by the engineer <b>MUST</b> be submitted back to the engineer with all items marked <b>COMPLETED</b> along with the signature and date of the person completing each item. _____ <b>Completed</b></li> <li><input type="checkbox"/> 4. All Pre-Functional Checklists (furnished by the contractor / supplier) must be completed and submitted back to the engineer with all items marked <b>COMPLETED</b> along with the signature and date of the person completing each item. _____ <b>Completed</b></li> <li><input type="checkbox"/> 5. All Checklists performed by systems vendor must be completed and submitted to the engineer with all items marked <b>COMPLETED</b> along with the signature and date of the person completing each item. _____ <b>Completed</b></li> <li><input type="checkbox"/> 6. The following people <b>MUST</b> be present at substantial completion observation by the engineer:             <ul style="list-style-type: none"> <li><input type="checkbox"/> MP&amp;E Contractors</li> <li><input type="checkbox"/> HVAC Controls Tech</li> <li><input type="checkbox"/> Fire Alarm System Tech</li> </ul>             _____ <b>Completed</b> </li> </ul>			

- 7. The MPE Contractor must have the following items on hand for the Substantial Completion Site Observation:
  - Six foot step ladder
  - Flash Light
  - Two radios for communicating (Electrical Contractor only)
  - Amp & Volt Meter (Electrical Contractor only)
  - Contract documents (plans, specs & submittals)
  - \_\_\_\_\_ **Completed**

**GENERAL ITEMS:**

1. The MP&E contractors shall sign below stating that ALL items required under the scope of division #15 and #16 have been provided / installed and is in proper working order. The signature below also states that ALL items provided under division #15 and #16 has been tested and are in proper working order.

\_\_\_\_\_ **MP&E Contractor's Signature of Completion**

\_\_\_\_\_ **Date of Signature**

**SPECIAL NOTE:**

**IF ALL ITEMS MENTIONED ABOVE ARE NOT COMPLETED AND THE CONTRACTOR SCHEDULES A SUBSTANTIAL COMPLETION SITE REVIEW WITH THE ENGINEER, THE ENGINEER WILL BE COMPENSATED BY THE CONTRACTOR AT CLA RETAIL RATES FOR EACH ADDITIONAL VISIT TO THE SITE.**

**SIGNATURE AND DATE OF SUBCONTRACTOR PERSON REQUESTING SUBSTANTIAL COMPLETION SITE VISIT BY ENGINEER.**

\_\_\_\_\_ (Subcontractor's Signature & Date)

**SIGNATURE AND DATE OF GENERAL CONTRACTOR STATING HE HAS REVIEWED THE PROJECT AND IT IS READY FOR SUBSTANTIAL COMPLETION SITE VISIT BY ENGINEER.**

\_\_\_\_\_ (General contractor's Signature & Date)

END OF SECTION 230800



**SECTION 232300 – REFRIGERANT PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.

**1.2 SUBMITTALS**

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
  - 1. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.
- C. Welding and brazing certificates
- D. Field quality-control test reports.
- E. Operation and maintenance data.

**1.3 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX; "Welding and Brazing Qualifications."
- B. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
- D. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Non-electrical"; or UL 429, "Electrically Operated Valves."

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Refrigerants:
    - a. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.
    - b. DuPont Company; Fluorochemicals Div.
    - c. Elf Atochem North America, Inc.; Fluorocarbon Div.
    - d. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.
  2. Refrigerant Valves and Specialties:
    - a. Climate & Industrial Controls Group; Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
    - b. Danfoss Electronics, Inc.
    - c. Emerson Electric Company; Alco Controls Div.
    - d. Henry Valve Company.
    - e. Sporlan Valve Company.

## 2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR
- B. Annealed-Temper Copper Tube: ASTM B 280, Type ACR
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Bronze Filler Metals: AWS A5.8, Classification BAg-1 (silver)

## 2.3 VALVES

- A. Packed-Angle Valves: 500-psig working pressure and 275 deg F working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.
- B. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.

- C. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

**2.4 REFRIGERANT PIPING SPECIALITIES**

- A. Moisture/Liquid Indicators: 500-psig maximum working pressure and 200 deg F operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.
- B. Replaceable-Core Filter-Dryers: 500-psig maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile-iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:
  - 1. Filter Cartridge: Pleated media with integral end rings, stainless-steel support, ARI 730 rated for capacity.
  - 2. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.
  - 3. Wax Removal Cartridge: Molded, bonded core of activated charcoal and desiccant with integral gaskets.
- C. Permanent Filter-Dryer: 350-psig maximum operating pressure and 225 deg F maximum operating temperature; steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

**2.5 REFRIGERANTS**

- A. ASHRAE 34, R-410A: Hydrofluorocarbon.

**PART 3 - EXECUTION**

**3.1 PIPING APPLICATIONS**

- A. Aboveground, within Building: Type ACR drawn-copper tubing.

### 3.2 VALVE APPLICATIONS

- A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor, for gage taps at hot-gas bypass regulators, on each side of strainers.
- B. Install check valves in compressor discharge lines and in condenser liquid lines on multiple condenser systems.
- C. Install packed-angle valve in liquid line between receiver shutoff valve and thermostatic expansion valve for system charging.
- D. Install diaphragm packless or packed-angle valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- E. Install thermostatic expansion valves as close as possible to evaporator.
  - 1. If refrigerant distributors are used, install them directly on expansion-valve outlet.
  - 2. Install valve so diaphragm case is warmer than bulb.
  - 3. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  - 4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install pressure-regulating and pressure relief valves as required by ASHRAE 15. Pipe pressure relief valve discharge to outside.

### 3.3 SPECIALTY APPLICATIONS

- A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.
- B. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.
- C. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.

### 3.4 PIPING INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 23 Section "Basic HVAC Materials and Methods."
- C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

- D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Belowground, install copper tubing in protective conduit. Vent conduit outdoors.
- G. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- H. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- I. Install bypass around moisture-liquid indicators in lines larger than NPS 2.
- J. Install unions to allow removal of solenoid valves, pressure-regulating valves, and expansion valves and at connections to compressors and evaporators.
- K. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.
- L. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".
- M. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe rollers for multiple horizontal runs 20 feet or longer, supported by a trapeze.
  - 4. Spring hangers to support vertical runs.
- N. Install hangers with the following maximum spacing and minimum rod sizes:
  - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
  - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  - 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  - 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

- O. Support vertical runs at each floor.

**3.5 PIPE JOINT CONSTRUCTION**

- A. Braze joints according to Division 23 Section "Basic HVAC Materials and Methods."
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

**3.6 FIELD QUALITY CONTROL**

- A. Test all refrigerant piping in accordance with all requirements of authority having jurisdiction, including any adopted federal, state or local regulations and amendments.
- B. In the absence of any state or local requirements test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
  - 1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
  - 2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.
    - a. System shall maintain test pressure at the manifold gage throughout duration of test.
    - b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
    - c. Fill system with nitrogen to raise a test pressure of 150 psig or higher as required by authorities having jurisdiction.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

**3.7 SYSTEM CHARGING**

- A. Charge system using the following procedures:
  - 1. Install core in filter-dryer after leak test but before evacuation.
  - 2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  - 4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 232300

**SECTION 233113 - METAL DUCTS**

**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 metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:
  - 1. Rectangular ducts and fittings.
  - 2. Single-wall, round, spiral-seam ducts and formed fittings.
- B. Related Sections include the following:
  - 1. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
  - 2. Division 23 Section "Diffusers, Registers, and Grilles."
  - 3. Division 23 Section "Testing, Adjusting, and Balancing" for duct leakage test, air balancing and final adjusting of manual-volume dampers.

**1.3 DEFINITIONS**

- A. FRP: Fiberglass-reinforced plastic.
- B. NUSIG: National Uniform Seismic Installation Guidelines.

**1.4 SYSTEM DESCRIPTION**

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect / Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

**1.5 SUBMITTALS**

- A. Shop Drawings: Show fabrication and installation details for metal ducts.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Fittings.
3. Reinforcement and spacing.
4. Seam and joint construction.
5. Penetrations through fire-rated and other partitions.
6. Equipment installation based on equipment being used on Project.
7. Duct accessories, including access doors and panels.
8. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

B. Field quality-control test reports.

C. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

#### 1.6 QUALITY ASSURANCE

A. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### 2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.



- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.3 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Joint and Seam Tape: 3 inches wide; 2 mil aluminum bonded to gray butyl adhesive, 15 mil total thickness equal to Hardcast Foil-Grip 1402; no exceptions.
- C. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- D. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- E. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

## 2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
  - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
  - 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## 2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and

complying 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 class.
  2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Nexus Inc.
    - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Lockformer.
  2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
  3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

## 2.6 ROUND DUCT AND FITTING FABRICATION

- A. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Duct Joints:
1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
  3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
  4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

- a. Manufacturers:
  - 1) Ductmate Industries, Inc.
  - 2) Lindab Inc.
  
- C. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
  
- D. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
  
- E. Fabricate elbows using die-formed or gored construction. Bend radius of die-formed and gored elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  2. Round Gored Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
    - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
    - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
  3. Die-Formed Elbows for Sizes through 12 Inches in Diameter: 0.040 inch thick with 2-piece welded construction.
  4. Round Elbows Larger Than 12 Inches in Diameter: Fabricate gored elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  5. Adjustable angle, multi-piece fittings shall not be used.

### PART 3 - EXECUTION

#### 3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
  1. Supply Ducts: 2-inch wg.
  2. Return Ducts (Negative Pressure): 2-inch wg.
  3. Outdoor Air Ducts: 2-inch wg.
  4. Exhaust Ducts (Negative Pressure): 2-inch wg.

**3.2 DUCT INSTALLATION**

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards-- Metal and Flexible," unless otherwise indicated.
- B. Install round ducts in lengths not less than 10 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."
- O. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems".

- P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."
- Q. Paint interiors of all metal ducts that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

### 3.3 SEAM AND JOINT SEALING

- A. Seal all duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated below:
  - 1. For pressure classes of 2-inch wg, or less, seal ALL transverse and longitudinal joints/seams and branch connections with solvent-based duct sealant.
- B. Clean all surfaces free of dirt, oil, grease, and loose or foreign matter that could impair adhesion, using soap and water or solvent. For maximum adhesion, rinse with a 50/50 mix of alcohol and water. Allow surfaces to dry completely before proceeding.
- C. Seal ducts before external insulation is applied.

### 3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.
- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

### 3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "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 FIELD QUALITY CONTROL

- A. A certified Test and Balance Agent shall assist in performing the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual". The role of the Test and Balance Agent is to witness the test, confirm the leakage calculations and prepare the test reports. The contractor shall provide the Test and Balance Agent a certified performance graph for the orifice used in the test apparatus. The certified orifice performance shall be matched to the orifice of the test apparatus by serial number. The installing contractor shall prepare the ductwork for testing, conduct preliminary testing to determine the duct is sealed and assist the Test and Balance Agent in accomplishing the following objectives:
1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
  3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
  4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

## 3.7 CLEANING NEW SYSTEMS

- A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
- B. Use service openings, as required, for physical and mechanical entry and for inspection.
1. Create other openings to comply with duct standards.
  2. Disconnect flexible ducts as needed for cleaning and inspection.
  3. Remove and reinstall ceiling sections to gain access during the cleaning process.
- C. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  4. Coils and related components.
  5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
  6. Supply-air ducts, dampers, actuators, and turning vanes.
- D. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

E. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and re-inspect ducts.

END OF SECTION 233113





**SECTION 233300 - DUCT ACCESSORIES**

**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 the following:
  - 1. Backdraft dampers.
  - 2. Manual-volume dampers.
  - 3. Turning vanes.
  - 4. Duct-mounted access doors and panels.
  - 5. Flexible Air Ducts.
  - 6. Flexible connectors.
  - 7. Duct accessory hardware.
- B. Related Sections include the following:
  - 1. Division 23 Section "Diffusers, Registers, and Grilles."

**1.3 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Backdraft dampers.
  - 2. Manual-volume dampers.
  - 3. Duct-mounted access doors and panels.
  - 4. Flexible Air Duct
  - 5. Flexible connectors.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
  - 1. Special fittings and manual- and automatic-volume-damper installations.
  - 2. Fire- and smoke-damper installations, including sleeves and duct-mounted access doors and panels.

- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

**1.4 QUALITY ASSURANCE**

- A. NFPA Compliance: Comply with the following NFPA standards:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

**PART 2 - PRODUCTS**

**2.1 SHEET METAL MATERIALS**

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- C. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.
- D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

**2.2 BACKDRAFT DAMPERS**

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.063-inch- thick extruded aluminum, with mounting flange.
- C. Blades: 0.025-inch- thick, roll-formed aluminum.
- D. Blade Seals: Neoprene.
- E. Blade Axles: Nonferrous.
- F. Tie Bars and Brackets: Aluminum.
- G. Return Spring: Adjustable tension.

## 2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
  - 1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- B. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
- C. Jackshaft: 1-inch- diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

## 2.4 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch- wide, curved blades set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into side strips suitable for mounting in ducts.
- C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## 2.5 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

- E. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

## 2.6 FLEXIBLE AIR DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Air Ducts, Insulated: Factory-fabricated, commercial series, insulated, round duct, with an outer jacket enclosing 2.25 inch- thick, R-Value 8.0, glass-fiber insulation around a continuous inner liner.
  - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
  - 2. Outer Jacket: Glass-reinforced, silver Mylar or 2-ply reinforced metalized polyester with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.
  - 3. Inner Liner: Polyethylene film or 2-ply black pigmented polyester.
- C. Pressure Rating: 6-inch wg positive, 1/2-inch wg negative.
- D. Surface Burning Characteristics: Maximum Flame Spread 25; Maximum Smoke Developed 50.

## 2.7 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.
- C. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.
- D. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.

## 2.8 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 length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- D. 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 shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install Flexible Air Duct per manufacturer's installation instructions:
  - 1. Maintain round, cross sectional area of the duct and insulation thickness throughout the entire run.
  - 2. Install ducts fully extended.
  - 3. Do not bend ducts across sharp corners.
  - 4. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  - 5. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  - 6. Install flexible ducts in a direct line, without sags, twists, or turns.
  - 7. Secure liner to metal ductwork with screwed clamps, draw bands. Attaching flexible air duct to sheet metal duct with sheet metal screws is unacceptable.
  - 8. Install duct tape per manufacturer's instruction to maintain vapor barrier. Clamps, draw bands, and tapes shall be labeled in accordance with Standard UL 181.
- E. Supporting Flexible Air Ducts:
  - 1. Suspend flexible ducts with bands 1-1/2 inches (38 mm) wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
  - 2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
  - 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
  - 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches on center.
- F. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
  - 1. Install fusible links in fire dampers.
- G. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.

1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
  2. Install access panels on side of duct where adequate clearance is available.
- H. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment".

**3.2 ADJUSTING**

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC".

**END OF SECTION 233300**

## SECTION 233423 – HVAC POWER VENTILATORS

## 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 the following:
  - 1. Ceiling-mounting ventilators.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on sea-level conditions.
- B. Operating Limits: Classify according to AMCA 99.

## 1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material gages and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.
  - 6. Roof curbs
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
  - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
- C. Coordination Drawings: Show roof penetration requirements and reflected ceiling plans drawn to scale and coordinating roof penetrations and units mounted above ceiling. Show the following:
  - 1. Roof framing and support members relative to duct penetrations.
  - 2. Ceiling suspension assembly members.
  - 3. Size and location of initial access modules for acoustical tile.

- 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

- D. Maintenance Data: For power ventilators to include in maintenance manuals specified in Division 1.

**1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

- D. UL Standard: Power ventilators shall comply with UL 705.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

- C. Lift and support units with manufacturer's designated lifting or supporting points.

**1.7 COORDINATION**

- A. Coordinate size and location of structural-steel support members.

- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

**1.8 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Belts: One set for each belt-driven unit.



**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Manufacturers:
    - a. Cook, Loren Company.
    - b. Greenheck Fan Corp.
    - c. Penn Ventilation Companies, Inc.

**2.2 CEILING-MOUNTING VENTILATORS**

- A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Isolation: Rubber-in-shear vibration isolators.
  - 3. Manufacturer's transition fittings.

**2.3 MOTORS**

- A. Comply with requirements in EPACT for energy efficient motors.
- B. Enclosure Type: Guarded dripproof or TEFC per schedule.

**2.4 SOURCE QUALITY CONTROL**

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install power ventilators level and plumb.
- B. Support units using spring isolators having a static deflection of 1 inch.
- C. Install units with clearances for service and maintenance.
- D. Coordinate roof opening and structural supports for roof-mounted fans.
- E. Label units according to requirements specified in Division 15 Section "Mechanical Identification."

**3.2 CONNECTIONS**

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment.
- D. 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.

**3.3 FIELD QUALITY CONTROL**

- A. Equipment Startup Checks:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Verify lubrication for bearings and other moving parts.
  - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 7. Disable automatic temperature-control operators.
- B. Starting Procedures:
  - 1. Energize motor and adjust fan to indicated rpm.
  - 2. Measure and record motor voltage and amperage.

- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- G. Replace fan and motor pulleys as required to achieve design airflow.
- H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

### 3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

### 3.5 CLEANING

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.
  - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 2. Review data in maintenance manuals. Refer to Division 1 Section "Closeout Procedures."
  - 3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

END OF SECTION 233423



**SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES**

**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 ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
  - 1. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
  - 2. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for balancing diffusers, registers, and grilles.

**1.3 DEFINITIONS**

- A. Diffuser: Square or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

**1.4 SUBMITTALS**

- A. Product Data: For each model indicated, include the following:
  - 1. Data Sheet: Indicate construction, finish, and mounting details for each type of air outlet, inlet, and accessory indicated.
  - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet indicated.
  - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories.
  - 4. Assembly Drawing: Indicate materials and methods of assembly of components for each type of air outlet and inlet indicated.

1.5 QUALITY ASSURANCE

- A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraphs titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

2.2 DIFFUSERS

- A. Diffuser: See Air Distribution Schedule.
  - 1. Available Products:
    - a. Air Systems Components, Krueger Div..
    - b. Anemostat Products, Dynamics Corp. of America.
    - c. Carnes Co. Inc..
    - d. E. H. Price.
    - e. Hart & Cooley, Inc.
    - f. Nailor Industries Inc.
    - g. Titus.
  - 2. Material: Steel.
  - 3. Finish: Baked enamel.
  - 4. Maximum Noise-Criterion Rating: 30 NC.
  - 5. Dampers: Opposed blade.

2.3 REGISTERS

- A. Register: See Air Distribution Schedule.
  - 1. Available Products:
    - a. Air Systems Components, Krueger Div..
    - b. Anemostat Products, Dynamics Corp. of America.
    - c. Carnes Co. Inc..
    - d. E. H. Price
    - e. Hart & Cooley, Inc.
    - f. Nailor Industries Inc.
    - g. Titus.
  - 2. Material: Steel.
  - 3. Finish: Baked enamel.
  - 4. Damper Type: Adjustable opposed-blade assembly.

**2.4 GRILLES**

A. Grille: See Air Distribution Schedule.

1. Available Products:

- a. Air Systems Components, Krueger Div..
- b. Anemostat Products, Dynamics Corp. of America.
- c. Carnes Co. Inc..
- d. E. H. Price
- e. Hart & Cooley, Inc.
- f. Nailor Industries Inc..
- g. Titus.

2. Material: Steel.

3. Finish: Baked enamel.

**2.5 SOURCE QUALITY CONTROL**

A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- B. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

END OF SECTION 233713





**SECTION 234100 – PARTICULATE AIR FILTRATION**

**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 factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

**1.3 SUBMITTALS**

- A. Product Data: Include dimensions; shipping, installed, and operating weights; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.
  - 1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
  - 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
  - 3. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

**1.4 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated. Other manufacturers systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. Comply with NFPA 90A.
- C. ASHRAE Compliance: Comply with provisions of ASHRAE 52.1 for method of testing and rating air-filter units.

**1.5 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

**1.6 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Provide one complete set of filters for each filter bank.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Air Filters and Filter-Holding Systems:
    - a. AAF International.
    - b. Continental Air Filter Div.; NiCon Filter Corp.
    - c. Farr Co.

**2.2 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS**

- A. Description: Factory-fabricated, dry, extended-surface filters with holding frames.
- B. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
- C. Media and Media-Grid Frame: Nonflammable cardboard.
- D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. See drawings for additional descriptions and requirements.
- B. Install filter frames according to manufacturer's written instructions.
- C. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

- D. Install filters in position to prevent passage of unfiltered air.
- E. Coordinate filter installations with duct and air-handling unit installations.

**3.2 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components, filter and filter-frame installation, and electrical wiring. Report results in writing.

**3.3 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100



**SECTION 238127 – DUCTLESS SPLIT-SYSTEM AIR-CONDITIONING UNITS****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 ductless, split-system heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed mounting without ductwork.

**1.3 SUBMITTALS**

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

**1.4 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. Units shall be designed to operate with HCFC-free refrigerants.

#### 1.5 COORDINATION

- A. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 7 Section "Roof Accessories."

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion.
  - 2. Compressor warranty Period: Six years from date of installation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Daikin AC (Americas), Inc.
  - 2. LG Electronics, Air Conditioning Division.
  - 3. Mitsubishi Electric; HVAC Division.

#### 2.2 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  - 1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
  - 2. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2004.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

- D. Fan: Direct drive, centrifugal fan.
- E. Fan Motors: Comply with requirements in Division 15 Section "Motors."
  - 1. Special Motor Features: Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
- F. Filters: Permanent, washable pleated.
- G. Integral condensate pump.

### 2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel in manufacturer's standard color, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - 1. Compressor Type: Scroll.
  - 2. Refrigerant Charge: R-410A.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Fan: Aluminum-propeller type, directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Kit: Permits cooling operation down to 14 deg F.
- G. Mounting Base: Polyethylene.

### 2.4 ACCESSORIES

- A. Thermostat: Wall-mounted, hard-wired thermostats to control compressor and evaporator fan, with the following features:
  - 1. Compressor time delay.
  - 2. 24-hour time control of system stop and start.
  - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  - 4. Fan-speed selection, including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

1. Minimum Insulation Thickness: 1/2 inch

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on galvanized equipment rail supports. Coordinate installation with roofing contractor. Anchor units to supports with removable, cadmium-plated fasteners.
- D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

**3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems".
- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

**3.3 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.



3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 1 Section for Closeout Procedures, Demonstration and Training.

END OF SECTION 238127



**INDEX OF ELECTRICAL SPECIFICATIONS**

**ELECTRICAL DIVISION**

260501	BASIC ELECTRICAL MATERIALS AND METHODS
260519	CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING
260532	RACEWAYS AND BOXES
260923	LIGHTING CONTROLS
262200	LOW VOLTAGE TRANSFORMERS
262416	PANELBOARDS
262726	WIRING DEVICES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
263323	CENTRAL BATTERY EQUIPMENT FOR EMEGENCY LIGHTING
265100	INTERIOR LIGHTING
265561	THEATRICAL LIGHTING SYSTEM
266100	ELECTRICAL SYSTEM COMMISSIONING
270528	OWNER FURNISHED COMMUNICATIONS SYSTEM
283111	ADDRESSABLE FIRE ALARM SYSTEM
289000	AUDIO VISUAL SYSTEMS



**SECTION 260501- BASIC ELECTRICAL MATERIALS AND METHODS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions shall apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Supporting devices for electrical components.
  - 2. Electrical identification.
  - 3. Concrete equipment bases.
  - 4. Cutting and patching for electrical construction.
  - 5. Touchup painting.
  - 6. Ceiling types used and coordination with lighting fixtures.

**1.3 SUBMITTALS**

- A. The contractor shall provide submittals on the following equipment:
  - 1. Lighting Fixtures (Interior and Exterior)
  - 2. Theatrical Lighting Systems
  - 3. Audio Visual Systems
  - 4. Electrical Panels and disconnects
  - 5. Dry-type Transformers
  - 6. Grounding and Bonding
  - 7. Hangers and Supports
  - 8. Lighting Controls
  - 9. Wiring devices
  - 10. Conduit, Fittings and Conductor
  - 11. Inverters
  - 12. Enclosed Switches & Breakers
  - 13. Fire Alarm System
  - 14. Commissioning Pre-functional Checklists (see 266100)
- B. Submittals shall be submitted electronic only (no hard copies).
- C. Submittals shall have the corresponding Specification Section indicated.
- D. Submittals shall have markings/highlighting to indicate selections to be reviewed. Submittal will be rejected if no indications are made.

- E. The review of any submittal and the marking of submittal with “NO COMMENTS” or other markings do not alleviate the need for the contractor to provide all items noted in the contract documents. The contractor must provide all items specified within the contract documents whether included in the submittal or not. Failure to include an item in a submittal does NOT mean that the contractor doesn’t have to provide that item.
- F. **The engineer will review submittals ONE time with ONE resubmittal per section. If the contractor does NOT submit an approvable submittal after these reviews the contractor will be billed at the engineer’s hourly rate (\$200 per hour) for all reviews beyond that point.**

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

#### 1.5 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
  - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Section on "Access Doors."
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- E. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

### PART 2 - PRODUCTS

#### 2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web. Support system shall be selected to suit structural loading.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Expansion Anchors: Carbon-steel wedge or sleeve type.
- G. Toggle Bolts: All-steel springhead type.
- H. Powder-Driven Threaded Studs: Heat-treated steel.

## 2.2 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by these Specifications.
- B. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

## 2.3 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Section on "Cast-in-Place Concrete."
- B. Concrete: 3000-psi, 28-day compressive strength as specified in Section on "Cast-in-Place Concrete."

## 2.4 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

## PART 3 - EXECUTION

### 3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

### 3.2 SUPPORT INSTALLATION

- A. Ceiling types used and coordination with lighting fixtures specified shall be done by the contractor prior to ordering fixtures. Provide all the necessary parts, frames, brackets and related items needed for the fixtures specified to mount in the type of ceiling specified by the Architect. This includes, but is not limited to: frames, brackets, and other items needed for gypsum board, lay-in (normal and narrow grid type). There shall be no light leaks or open space between the fixture and frame or grid. This could result in fixtures having to be replaced at contractor's expense, if this isn't done. No change order will be issued for this item.
- B. Install support devices to securely and permanently fasten and support electrical components.
- C. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- D. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- E. Size supports for multiple raceway installations so capacity can be increased by a 25 percent in the future.
- F. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- G. Install minimum 3/8-inch-diameter or larger threaded steel hanger rods, as required for load indicated.
- H. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- I. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- J. Simultaneously install vertical conductor supports with conductors.



- K. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- L. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- M. Install sleeves for cable and raceway penetrations of concrete slabs and walls. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- N. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
  - 1. Wood: Fasten with wood screws or screw-type nails.
  - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  - 3. New Concrete: Concrete inserts with machine screws and bolts.
  - 4. Existing Concrete: Expansion bolts.
  - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
  - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
    - a. Field Welding: Comply with AWS D1.1.
  - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
  - 8. Light Steel: Sheet-metal screws.
  - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.3 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Identify raceways by spot painting as follows:
  - 1. Band Locations: At changes in direction, at penetrations of walls and floors, at 25-foot intervals.
  - 2. Colors: As follows:
    - a. Normal Power: Black.

b. Communications: White.

- D. ALL exposed conduits shall be painted (entire length of conduit) with colors outlined above.
- E. Fire Alarm System conduits and boxes shall be RED as specified in Specification Section 283111.
- F. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

### 3.4 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Section on "Firestopping."

### 3.5 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section on "Cast-in-Place Concrete."

### 3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Fire Alarm
  - 6. Concrete bases.
  - 7. Cutting and patching for electrical construction.
  - 8. Touchup painting.

**3.8 REFINISHING AND TOUCHUP PAINTING**

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Section on "Painting."
  - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 4. Repair damage to paint finishes with matching touch-up coating recommended by manufacturer.

**3.9 CLEANING AND PROTECTION**

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

**3.10 DEMOLITION REQUIREMENTS**

- A. The contractor shall visit the site before submitting a bid to observe the existing condition and installation.
- B. Work in the existing building shall be scheduled well in advance with the owner. Work shall be performed at such times and under such conditions as to suit the convenience of the owner. Plan the work to minimize disruption of normal operation. The contractor must perform work at the time the owner directs.
- C. Remove wiring devices, fixtures, components, electrical equipment, conductors, boxes, and conduits not required to remain in service in remodeled areas when this project is complete.
- D. Where existing equipment and devices are required or needed to remain, reconnect these devices / equipment and/or circuits to other panelboards when required to complete the renovation shown.
- E. Remove existing conduit and wire from areas to be remodeled, back to panelboard, cabinet or junction box. Where such work would not be possible without disturbing areas not being renovated, consult with the architect prior to performing this work.
- F. Where a circuit is interrupted by removal of a device or fixture from that circuit, install wire and conduit as required to restore service to the remaining devices and fixtures on that circuit.

- G. Lighting fixtures, wiring devices, panelboards, and conductors removed shall be offered to the owner. If he chooses to retain these items or part of these items, turn them over to him. Items rejected by the owner shall be removed from the project site by the contractor.

END OF SECTION 260501

**SECTION 260519 - CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Sleeves and sleeve seals for cables.

**1.3 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

**1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by the contractor acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

**1.6 COORDINATION**

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

**PART 2 - PRODUCTS****2.1 CONDUCTORS AND CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Aluminum conductors are NOT allowed.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THWN and XHHW types (75 degree "C" rated). ALL conductors used must be listed in NEC Table 310.16 (2008) under the 75 degree C temperature rating.
- E. Multiconductor Cable: These are NOT allowed to be used on this project.

**2.2 CONNECTORS AND SPLICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Pressure type connectors as manufactured by WAGO are NOT allowed to be used.

**PART 3 - EXECUTION****3.1 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Copper type must be provided – all sizes.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

- C. Fire Alarm System Cabling: Solid type conductor, stranded conductor may NOT be used on this project.
- D. **Three-Phase Homeruns** The circuits are shown on the drawings as single circuit homeruns. The contractor may combine up to three (3) circuits together into a single homerun. The circuits that are combined must be phase A, phase B and phase C. This would mean that a three circuit home-run would include 3 phase conductors (A,B&C), three neutral conductors (neutrals are not allowed to be shared) and one equipment ground conductor (equipment ground can be shared for the three circuits). It should be noted that this installation is considered to be six (6) current carrying conductors and amp rating of conductors shall be reviewed accordingly. See 2008 NEC Table 310.15(B)(2)(a) for proper adjustments required.
- E. The contractor can NOT combine three phase circuits in the same conduit. He shall also not combine 208V-1ph, 240V-1ph or 480-V-1ph circuits in the same conduit.
- F. Provide colored conductors for all FEEDER and BRANCH circuits for 208Y/120 volt systems as follows:
1. Phase A: Black.
  2. Phase B: Red.
  3. Phase C: Blue.
  4. Neutral (phase A): White with BLACK stripe.
  5. Neutral (phase B): White with RED stripe.
  6. Neutral (phase C): White with BLUE stripe.
  7. Ground: Green.
- G. Provide colored conductors for all FEEDER and BRANCH circuits for 480Y/277 volt systems as follows:
1. Phase A: Brown.
  2. Phase B: Orange
  3. Phase C: Yellow.
  4. Neutral: Gray.
  5. Neutral (phase A): Gray with BROWN stripe.
  6. Neutral (phase B): Gray with ORANGE stripe.
  7. Neutral (phase C): Gray with YELLOW stripe.
  8. Ground: Green
- H. The contractor MUST use conductors with the jacket color mentioned above. Colored phasing tape on the ends of conductors is NOT acceptable.
- 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS
- A. Exposed Feeders (inside): Type THWN, single conductors in raceway.
- B. Exposed Feeders (outside): Type THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THWN, single conductors in raceway.

- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THWN, single conductors in raceway.
- H. Class 1 Control Circuits: Type THWN, in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed conduit or cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible. All exposed conduit must be approved by engineer prior to installation.
- E. Support cables according to Section on "Basic Electrical Materials and Methods".
- F. Identify and color-code conductors and cables according to Section on "Basic Electrical Materials and Methods."
- G. The contractor shall use the next larger conductor for all conductor runs longer than 150'-0".

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
- C. Branch circuit splices shall be made using UL approved wire nuts. Pressure type connectors are NOT allowed. Wire nuts shall be tightened per manufacturer's recommendation and electrical tape shall be applied around wire nut.
- D. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.



**3.5 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section on "Through-Penetration Firestop Systems."

**3.6 FIELD QUALITY CONTROL**

- A. Testing: Must be done by a qualified person and shall perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519



**SECTION 260526 - GROUNDING AND BONDING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and apply to this Section.

**1.2 SUMMARY**

- A. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
  - 1. Branch circuit grounding.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Qualification Data: Contractor must be familiar with grounding requirements as outlined in the National Electrical Code.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For grounding to include in operation and maintenance manuals. In addition to items specified in Section on "Operation and Maintenance Data," include the following:
  - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems and grounding electrode system.
    - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
    - b. Include recommended testing intervals.

**1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

## 2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 2" X 24" X 1/8" DEEP, with 3/8-inch holes spaced 2" apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

## 2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected. All connectors shall be UL rated for grounding use.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts. Bolts must be non-reversing type and UL rated for use with Grounding system.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad sectional type; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.
- B. Chemical-Enhanced Grounding Electrodes shall not be used.

**PART 3 - EXECUTION****3.1 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 12 AWG and smaller, and stranded conductors for No. 10 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.
  - 1. Bury at least 24 inches (600 mm) below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in communications rooms and elsewhere as indicated.
  - 1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
- E. Conductor Terminations and Connections:
  - 1. Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors.
  - 3. Connections to Ground Rods: Welded connectors.
  - 4. Connections to Structural Steel: Welded connectors.

**3.2 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
- C. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

### 3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
  - 4. Install copper conductor not less than No. 3/0 AWG for ground ring and for taps to building steel.
  - 5. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified person to perform tests and inspections.
- B. Perform tests and inspections.
  - 1. Engage a trained representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
  - 2. Provide documentation to the engineer that all connections have been made per code and per these specifications.
- C. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports and give to engineer.

END OF SECTION 260526





**SECTION 260532 - RACEWAYS AND BOXES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

**1.2 SUMMARY**

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

**1.3 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. NBR: Acrylonitrile-butadiene rubber.
- H. RNC: Rigid nonmetallic conduit.
- I. RSC: Rigid steel conduit

**1.4 SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, cabinets and EZ-Path Fire Stop system.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Custom enclosures and cabinets.
  - 2. For handholes and boxes for underground wiring, including the following:
    - a. Duct entry provisions, including locations and duct sizes.
    - b. Frame and cover design.

- c. Grounding details.
  - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
  - e. Joint details.
- C. Qualification Data: For professional engineer and testing agency.
- D. Source quality-control test reports.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. AFC Cable Systems, Inc.
  - 2. Alflex Inc.
  - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 5. Electri-Flex Co.
  - 6. Manhattan/CDT/Cole-Flex.
  - 7. Maverick Tube Corporation.
  - 8. O-Z Gedney; a unit of General Signal.
  - 9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. PVC-Coated Steel Conduit: PVC-coated **rigid steel conduit**.
- 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- E. EMT: ANSI C80.3.
- F. FMC: Zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket.

- H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
  - 2. Fittings for EMT: Steel compression type.
- I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

## 2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 3. Arco Corporation.
  - 4. CANTEX Inc.
  - 5. CertainTeed Corp.; Pipe & Plastics Group.
  - 6. Condux International, Inc.
  - 7. ElecSYS, Inc.
  - 8. Electri-Flex Co.
  - 9. Lamson & Sessions; Carlon Electrical Products.
  - 10. Manhattan/CDT/Cole-Flex.
  - 11. RACO; a Hubbell Company.
  - 12. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, **Type EPC-80-PVC**, unless otherwise indicated.
- C. LFNC: UL 1660.
- D. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

## 2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Square D; Schneider Electric.
  - 4. Wiremold
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

#### 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  - 2. EGS/Appleton Electric.
  - 3. Erickson Electrical Equipment Company.
  - 4. Hoffman.
  - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  - 6. O-Z/Gedney; a unit of General Signal.
  - 7. RACO; a Hubbell Company.
  - 8. Robroy Industries, Inc.; Enclosure Division.
  - 9. Scott Fetzer Co.; Adalet Division.
  - 10. Spring City Electrical Manufacturing Company.
  - 11. Thomas & Betts Corporation.
  - 12. Walker Systems, Inc.; Wiremold Company (The).
  - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
  - 14. Quazite
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Metal Floor Boxes: Cast metal fully adjustable, rectangular.
- E. Nonmetallic Floor Boxes: Nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- I. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

**PART 3 - EXECUTION****3.1 RACEWAY APPLICATION – Power Feeders, Communications Systems and Branch Circuits****A. OUTDOORS: Apply raceway products as specified below, unless otherwise indicated:**

1. Exposed Conduit (power and communications systems feeders, branch circuits or workstation communications branch conduit): Vinyl Coated Rigid steel conduit.
2. Concealed Conduit, Aboveground (branch circuits and workstation communications branch conduit): EMT conduit.
3. Concealed Conduit, Aboveground (power and communications systems feeders): Vinyl Coated Rigid steel conduit.
4. Underground Conduit (power and communications systems feeders, branch circuits or workstation communications branch conduit): RNC, Type EPC-80-PVC, must transition to rigid steel (mastic coated) at last 90 degree turn before emerging from ground.
5. Power and communications feeder conduits installed underground or under slab shall be 36" LONG RADIUS rigid type.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R. Where exposed to wastewater provide stainless steel NEMA 4X.

**B. INDOORS: Comply with the following indoor applications, unless otherwise indicated:**

1. Exposed Power and Communications systems feeders, Not Subject to Physical Damage (above 10'-0" AFF): IMC type.
2. Exposed Power and Communications systems feeders below 10'-0" AFF: Rigid Steel type.
3. Exposed branch circuits and workstation communications branch conduit, Not subject to Physical Damage: EMT type
4. Exposed power feeders, communication systems feeders, workstation communication branch conduit and branch circuits, subject to physical damage: Rigid steel conduit.
5. Power and communications system feeders concealed in ceilings and interior walls and partitions: IMC type.
6. Power and communications feeder conduits installed underground or under slab shall be 36" LONG RADIUS rigid type.
7. Branch circuits and workstation communication branch conduit concealed in ceilings and interior walls and partitions: EMT type.
8. Connection to vibrating equipment (Including Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
9. Connection to dry-type Transformers: LFMC.
10. Damp or Wet Locations: Rigid steel conduit.

11. Raceways in Spaces Used for environmental return air: see types mentioned above – NO PVC is allowed for this application.
  12. Raceways for risers in Vertical Shafts: see types mentioned above.
- C. Minimum Raceway Size – Power / Lighting: 1/2” trade size.
  - D. Minimum Raceway Size – Communications: 1” trade size.
  - E. Minimum Raceway Size – Fire Alarm: 1/2” trade size.
  - F. Conduit for voice and data system workstation outlets shall be installed from workstation out to above accessible corridor ceiling. Provide a bushing in the end of communications outlets.
  - G. Raceway Fittings: Compatible with raceways and suitable for use and location.
    1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
    2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
  - H. Aluminum conduit is NOT allowed without specific approval in writing from the engineer.
  - I. See “Systems Coordination Schedule” on the drawings for conduit requirements.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 12 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. ALL ELECTRICAL DEVICES SHALL BE INSTALLED IN JUNCTION BOXES. THIS INCLUDES WIRELESS DEVICES. Boxes for switches (wireless and wired) shall be a minimum of 4 11/16” square with single gang plaster ring. The exact size box shall be coordinated with the number of devices required.
- D. Complete raceway installation before starting conductor installation.
- E. Support raceways as specified in Section on "Basic Electrical Materials and Methods."
- F. Arrange stub-ups so curved portions of bends are not visible above the finished slab. All stubs must transition to rigid prior to last 90 degree turn before emerging from slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

- I. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  2. The maximum conduit in slab shall be 1 ¼" unless special permission is given by structural engineer.
  3. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  4. Change from schedule 40 PVC conduit to rigid metal conduit at last 90 degree bend before it emerges from slab. Transition from rigid metal conduit to EMT above finished floor as outlined herein.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: [125 deg F (70 deg C)] <Insert temperature> temperature change.
    - d. Attics: 135 deg F (75 deg C) temperature change.
  2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.

- 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
  
- O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
  
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall.
  
- Q. Set metal floor boxes level and flush with finished floor surface.
  
- R. Flexible whips are not allowed to rest on ceilings. Tie all whips up off ceiling.
  
- S. ALL conduits that penetrate roofs MUST be coordinated with and comply with the requirements of the roofing contractor's requirements for roof penetrations.

**3.3 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Section on "Through-Penetration Firestop Systems."
  
- B. Sleeves in fire rated walls shall be EZ-Path fire rated firestops system. Provide model number for the cables to be used PLUS 50% spare capacity. Provide a submittal on this item

**3.4 PROTECTION**

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260532



SECTION 260943 - LIGHTING CONTROLS

PART 1 - GENERAL

1.1 Summary

- .1 Section includes a networked lighting control system comprised of the following components:
  - .1 System Software Interfaces
    - .1 Management Interface
    - .2 Visualization Interface
    - .3 Smartphone Programming Interface for Wired Devices
  - .2 System Backbone and Integration Equipment
    - .1 System Controller
  - .3 Wired Networked Devices
    - .1 Wall Stations
    - .2 Graphic Wall Stations
    - .3 Digital Key Switches
    - .4 Auxiliary Input/Output Devices
    - .5 Occupancy and Photocell Sensors
    - .6 Wall Switch Sensors
    - .7 Embedded Sensors
    - .8 Power Packs and Secondary Packs
    - .9 Networked Luminaires
    - .10 Relay and Dimming Panel
    - .11 Bluetooth® Low Energy Programming Device
    - .12 Communication Bridge
- .2 The networked lighting control system shall meet all the characteristics and performance requirements specified herein.
- .3 The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

1.2 Related Documents

- .1 Section 26 27 26 Wiring Devices
- .2 Section 26 09 23 Lighting Control Devices

- .3 Section 26 09 43.13 Digital-Network Lighting Controls
- .4 Section 26 09 43.16 Addressable Fixture Lighting Control
- .5 Section 26 51 13 Interior Lighting Fixtures

### 1.3 Submittals

- .1 Submittal shall be provided including the following items.
  - .1 Bill of Materials necessary to install the networked lighting control system.
  - .2 Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
  - .3 Riser Diagrams showing device wiring connections of system backbone and typical per room/area type.
  - .4 Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
  - .5 Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
  - .6 Contractor Startup/Commissioning Worksheet (must be completed prior to factory start-up).
  - .7 Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
  - .8 Hardware and Software Operation Manuals.

### 1.4 Approvals

- .1 Prior approval from owner's representative is required for products or systems manufactured by companies not specified in the Network Lighting Controls section of this specification.
- .2 Any alternate product or system that has not received prior approval from the owner's representative at least 10 days prior to submission of a proposal package shall be rejected.
- .3 Alternate products or systems require submission of catalog datasheets, system overview documents and installation manuals to owner's representative.

### 1.5 Quality Assurance

- .1 Product Qualifications
  - .1 System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
  - .2 System shall be listed as qualified under DesignLights Consortium Networked Lighting Control System Specification V2.0.
  - .3 System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.

- .4 All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
- .5 All components and the manufacturing facility where product is manufactured must be RoHS compliant.
- .2 Installation and Startup Qualifications
  - .1 System start-up shall be performed by qualified personnel approved or certified by the manufacturer.
- .3 Service and Support Requirements
  - .1 Phone Support: Toll free technical support shall be available.
  - .2 Remote Support: The bidder shall offer a remote support capability.
  - .3 Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
  - .4 Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

**1.6 Project Conditions**

- .1 Only install indoor equipment after the following site conditions are maintained:
  - .1 Ambient Temperature: 14 to 105 degrees F (-10 to 40 degrees C)
  - .2 Relative Humidity: less than 90% non-condensing
- .2 Equipment shall not be subjected to dust, debris, moisture, or temperature and humidity conditions exceeding the requirements indicated above or as marked on the product, at any point prior to installation.
- .3 Only properly rated equipment and enclosures, installed per the manufacturer's instructions, may be subjected to dust and moisture following installation.

**1.7 Warranty**

- .1 The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.
- .2 The hardware warranty shall cover repair or replacement any defective products within the warranty period.

**1.8 Maintenance & Sustainability**

- .1 The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

**PART 2 - EQUIPMENT**

**2.1 System Compliance**

- .1 System components shall comply with UL 916 and UL 924 standards where applicable.
- .2 System components shall comply with CFR Title 47, Part 15 standards where applicable.
- .3 System components shall comply with ISED Canada RSS-247 standards where applicable.
- .4 All equipment shall be installed and connected in compliance with NFPA 70.

## 2.2 System Performance Requirements

### .1 System Architecture

- .1 System shall have an architecture that is based upon three main concepts: (1) networkable intelligent lighting control devices, (2) standalone lighting control zones using distributed intelligence, (3) optional system backbone for remote, time based and global operation.
- .2 Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
- .3 System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see *Control Zone Characteristics* sections for each type of network connection).
- .4 Networked luminaires and intelligent lighting control devices shall support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.
- .5 Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”
  - .1 Lighting control zones of at least 128 devices per zone shall be supported.
- .6 Networked luminaires and intelligent lighting control devices shall have distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones shall operate according to their defined default settings and sequence of operations.
- .7 Lighting control zones shall be capable of being networked with a higher-level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software interface.
- .8 The system may include one or more system controllers that provide time-based control. The system controller also provides a means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP or BACnet MS/TP protocol.

- .9 All system devices shall support firmware update, either remotely or from within the applications space, for purposes of upgrading functionality at a later date.
- .2 Wired Networked Control Zone Characteristics
  - .1 Connections to devices within a wired networked lighting control zone and to backbone components shall be with a single type of low voltage network cable, which shall be compliant with CAT5e specifications or higher. To prevent wiring errors and provide cost savings, the use of mixed types of low voltage network cables shall not be permitted.
  - .2 Devices in an area shall be connected via a “daisy-chain” topology; requiring all individual networked devices to be connected back to a central component in a “hub-and-spoke” topology shall not be permitted, so as to reduce the total amount of network cable required for each control zone.
  - .3 System shall provide the option of having pre-terminated plenum rated low voltage network cabling supplied with hardware so as to reduce the opportunity for improper wiring and communication errors during system installation.
  - .4 Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g. software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
  - .5 Once software is installed, system shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
  - .6 All networked devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.
  - .7 Networked control devices intended for control of egress and/or emergency light sources shall not require the use of additional, externally mounted UL924 shunting and/or 0-10V disconnect devices, so as to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
    - .1 Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
    - .2 UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay and provide 100% light output upon detection of loss of power sensed via line voltage connection to normal power.
  - .8 Networked luminaires and intelligent lighting control devices located in different areas shall be able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span across multiple areas. Occupancy and photocell commands shall be available across a single controller, and switch commands shall be available across single or multiple controllers. These shall also be referred to as global control zones.
  - .9 Wired networked Wall stations shall provide the follow Scene Control Capabilities:

- .1 Preset Scenes that can activate a specific combination of light levels across multiple local and global channels, as required.
  - .2 Profile Scenes that can modify the sequence of operation for the devices in the area (group) in response to a button press. This capability is defined as supporting “Local Profiles” and is used to dynamically optimize the occupant experience and lighting energy usage. Wall stations shall be able to manually start and stop Local Profiles, or the local profile shall be capable of ending after a specific duration of time between 5 minutes and 12 hours. Parameters that shall be configurable and assigned to a Local Profile shall include, but not be limited to, fixture light level, occupancy time delay, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.
  - .3 3-way / multi-way control: multiple wall stations shall be capable of controlling the same local and global control zones, so as to support “multi-way” preset scene and profile scene control.
- .3 System Integration Capabilities
- .1 The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet MS/TP protocols. The following system integration capabilities shall be available via BACnet/IP and BACnet MS/TP protocols:
    - .1 The system shall support control of individual devices, including, but not limited to, control of relay and dimming output.
    - .2 The system shall support reading of individual device status information. The available status will depend on the individual device type and capabilities, which may include but not be limited to, relay state, dimming output, power measurement, occupancy sensor status, and photocell sensor states or readings. All system devices shall be available for polling for devices status.
    - .3 The system shall support activation of pre-defined system Global Profiles (see *Supported Sequence of Operations for further definition of Global Profile capabilities*).
  - .2 The system shall support activation of Global Profiles from third party systems by receiving dry contact closure output signals or digital commands via RS-232/RS-485. (See *Supported Sequence of Operations for further definition of Profile and Scene Preset capabilities*.)
  - .3 The system shall support activation of demand response levels from Demand Response Automation Servers (DRAS) via the OpenADR 2.0a protocol.
- .4 Supported Sequence of Operations
- .1 Control Zones
    - .1 Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) shall be capable of transmitting and tracking occupancy sensor, photocell sensor, and manual switch information within at least 48 unique control zones to support different and reconfigurable sequences of operation within the area. These shall also be referred to as local control zones.

- .2 Wall station Capabilities
  - .1 Wall stations shall be provided to support the following capabilities:
    - .1 On/Off of a local control zone.
    - .2 Continuous dimming control of light level of a local control zone.
  - .2 3-way / multi-way control: multiple wall stations shall be capable of controlling the same local control zones, so as to support “multi-way” switching and/or dimming control.
- .3 Occupancy Sensing Capabilities
  - .1 Occupancy sensors shall be configurable to control a local zone.
  - .2 Multiple occupancy sensors shall be capable of controlling the same local zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zones.
  - .3 System shall support the following types of occupancy sensing sequence of operations:
    - .1 On/Off Occupancy Sensing
    - .2 Partial-On Occupancy Sensing
    - .3 Partial-Off Occupancy Sensing
    - .4 Vacancy Sensing (Manual-On / Automatic-Off)
  - .4 On/Off, Partial-On, and Partial-Off Occupancy Sensing modes shall function according to the following sequence of operation:
    - .1 Occupancy sensors shall automatically turn lights on to a designated level when occupancy is detected. To support fine tuning of Partial-On sequences the designated occupied light level shall support at least 100 dimming levels.
    - .2 Occupancy sensors shall automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels.
    - .3 To provide additional energy savings the system shall also be capable of combining Partial-Off and Full-Off operation by dimming the lights to a designated level when vacant and then turning the lights off completely after an additional amount of time.
    - .4 Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under *Photocell Sensing Capabilities*.

- .5 The use of a wall station shall change the dimming level or turn lights off as selected by the occupant. The lights shall optionally remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.
- .5 Vacancy Sensing mode (also referred to as Manual-On / Automatic-Off) shall function according to the following sequence of operation:
  - .1 The use of a wall station is required turn lights on. The system shall be capable of programming the zone to turn on to either to a designated light level or the previous user light level. Initially occupying the space without using a wall station shall not result in lights turning on.
  - .2 Occupancy sensors shall automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels.
  - .3 To provide additional energy savings and an enhanced occupant experience, the system shall also be capable of dimming the lights when vacant and then turning the lights off completely after an additional amount of time.
  - .4 To minimize occupant impact in case the area or zone is still physically occupied following dimming or shutoff of the lights due to detection of vacancy, the system shall support an “automatic grace period” immediately following detection of vacancy, during which time any detected occupancy shall result in the lights reverting to the previous level. After the grace period has expired, the use of a wall station is required to turn lights on.
  - .5 Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under *Photocell Sensing Capabilities*.
  - .6 At any time, the use of a wall station shall change the dimming level or turn lights off as selected by the occupant. The lights shall optionally remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.
- .6 To accommodate diverse types of environments, occupancy time delays before dimming or shutting off lights shall be specifiable for control zones between 15 seconds to 2 hours.
- .4 Photocell Sensing Capabilities (Automatic Daylight Sensing)
  - .1 Photocell sensing devices shall be configurable to control a local zone.
  - .2 The system shall support the following type of photocell-based control:



- .1 Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.
- .5 Schedule Capabilities
    - .1 System shall support the creation of time schedules for time-of-day override of devices including offsets from dusk and dawn.
    - .2 System shall support blink warning and timed extension capabilities. At the end of a scheduled period, the system shall be capable of providing a visible “blink warning” 5 minutes prior to the end of the schedule. Wall stations may be programmed to provide timed overrides that turn the lights on for an additional period of time. Timed override duration shall be programmable for each individual device, zone of devices, or customized group of devices, ranging from 5 minutes to 12 hours.
  - .6 Global Profile Capabilities
    - .1 The system shall be capable of automatically modifying the sequence of operation for selected devices in response to any of the following: a time-of-day schedule, contact closure input state, manually triggered wired wall station input, RS-232/RS-485 command to wired input device, and BACnet input command. This capability is defined as supporting “Global Profiles” and is used to dynamically optimize the occupant experience and lighting energy usage.
    - .2 Global profiles may be scheduled with the following capabilities:
      - .1 Global Profiles shall be stored within and executed from the system controller (via internal timeclock) such that a dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
      - .2 Global Profile time-of-day schedules shall be capable of being given the following recurrence settings: daily, specific days of week, every “n” number of days, weekly, monthly, and yearly. Lighting control profile schedules shall support definition of start date, end date, end after “n” recurrences, or never ending. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
      - .3 Global Profile Holiday Schedules should follow recurrent settings for specific US holiday dates regardless if they always occur on a specific date or are determined by the day/week of the month.
      - .4 Global Profiles shall be capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
      - .5 Software management interface shall be capable of displaying a graphic calendar view of profile schedules for each control zone.
    - .3 System Global Profiles shall have the following additional capabilities:

- .1 Global Profiles shall be capable of being manually activated directly from the system controller, specially programmed wired input devices, scene capable wired wall stations, and the software management interface.
- .2 Global Profiles shall be selectable to apply to a single device, zone of devices, or customized group of devices.
- .3 Parameters that shall be configurable and assigned to a Global Profile shall include, but not be limited to, fixture light level, occupancy time delay, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.
- .4 A backup of Local and Global Profiles shall be stored on the software's host server such that the Profile backup can be applied to a replacement system controller or wired wall station.
- .7 System shall support automated demand response capabilities with automatic reduction of light level to at least three levels of demand response.

### 2.3 System Software Interfaces

#### .1 Management Interface

- .1 System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
- .2 Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
- .3 Management interface shall require all users to login with a User Name and Password, and shall support creation of at least 100 unique user accounts.
- .4 Management interface shall support at least three permission levels for users: read-only, read & change settings, and full administrative system access.
- .5 Management interface shall be capable of restricting access for user accounts to specific devices within the system.
- .6 All system devices shall be capable of being given user-defined names.
- .7 The following device identification information shall be displayed in the Management interface: model number, model description, serial number or network ID, manufacturing date code, custom label(s), and parent network device.
- .8 Management interface shall be able to read the live status of a networked luminaire or intelligent control device and shall be capable of displaying luminaire on/off status, dim level, power measurement, device temperature, PIR occupancy sensor status, microphonic occupancy sensor status, remaining occupancy time delay, photocell reading, and active Profiles.

- .9 Management interface shall be able to read the current active settings of a networked luminaire or intelligent control device and shall be capable of displaying dimming trim levels, occupancy sensor and photocell enable/disable, occupancy sensor time delay and light level settings, occupancy sensor response (normal or vacancy), and photocell setpoints and transition time delays.
  - .10 Management interface shall be able to change the current active settings and default settings for an individual networked luminaire or intelligent control device.
  - .11 Management interface shall be capable of applying settings changes for a zone of devices or a group of selected devices using a single "save" action that does not require the user to save settings changes for each individual device.
  - .12 A printable network inventory report shall be available via the management interface.
  - .13 A printable report detailing all system profiles shall be available via the management interface.
  - .14 All sensitive information stored by the software shall be encrypted.
  - .15 All system software updates must be available for automatic download and installation via the internet.
- .2 Visualization and Programming Interfaces
- .1 System shall provide an optional web-based visualization interface that displays graphical floorplan.
  - .2 Graphical floorplan shall offer the following types of system visualization:
    - .1 Full Device Option - A master graphic of the entire building, by floor, showing each control device installed in the project with zones outlined. This shall include, but not be limited to, the following:
      - .1 Controls embedded light fixtures
      - .2 Controls devices not embedded in light fixtures
      - .3 Daylight Sensors
      - .4 Occupancy Sensors
      - .5 Wall Switches and Dimmers
      - .6 Scene Controllers
      - .7 Networked Relays
      - .8 Wired Bridges
      - .9 System Controllers
      - .10 Wired Relay Panels
      - .11 Group outlines

- .2 Group Only Option - A master graphic of the entire building, by floor, showing only control groups outlined.
- .3 Allow for pan and zoom commands so smaller areas can be displayed on a larger scale simply by panning and zooming each floor's master graphic.
- .4 A mouse click on any control device shall display the following information (as applicable):
  - .1 The device catalog number.
  - .2 The device name and custom label.
  - .3 Device diagnostic information.
  - .4 Information about the device status or current configuration is available with an additional mouse click.
- .3 Smartphone Programming Interface for Wired Devices
  - .1 Application interface shall be provided for both Apple iOS® and Android operating systems that allows configuration of lighting control settings.
  - .2 The application shall support the configuration and control of wired networked control devices via a Bluetooth® Low Energy (BLE) Programming Device.
    - .1 Application shall support a security pin-code to access the zone of lighting control devices.
    - .2 The application shall provide indication of signal strength where multiple Bluetooth Low Energy Programming Devices are available for configuration.
    - .3 The application shall indicate the number of wired networked control devices connected to the local daisy-chain zone.
    - .4 The application shall provide on/off/dimming control of all control groups.
    - .5 The application shall provide the ability to identify all individual luminaires and control devices.
  - .3 Programming capabilities through the application shall include, but not be limited to, the following:
    - .1 Switch/occupancy/photosensor zone configuration
    - .2 Manual/automatic on modes
    - .3 Turn-on dim level
    - .4 Occupancy sensor time delays
    - .5 Dual technology occupancy sensors sensitivity
    - .6 Photosensor calibration adjustment and auto-setpoint
    - .7 Multiple photosensor zone offset
    - .8 Trim level settings

- .9 Preset scene creation and copy for scene capable devices.
- .10 Application of custom device labels to the Bluetooth Low Energy Programming Devices and individual connected lighting control devices.
- .11

**2.4 System Backbone and System Integration Equipment**

**.1 System Controller**

- .1 System Controller shall be multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
- .2 System Controller shall have 32-bit microprocessor operating at a minimum of 1 GHz.
- .3 System Controller shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases.
- .4 System Controller shall perform the following functions:
  - .1 Time-based control of downstream network devices.
  - .2 Linking into an Ethernet network.
  - .3 Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
  - .4 Connection to various software interfaces, including management interface, historical database and analytics interface, and visualization interface.
- .5 System Controller shall have an integral web server to support configuration, diagnostics and hosting of software interfaces.
- .6 Device shall have option for a graphical touch screen to support configuration and diagnostics.
- .7 Device shall have three RJ-45 networked lighting control ports for connection to any of the following:
  - .1 The graphical touch screen
  - .2 Wired communication bridges
  - .3 Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port)
- .8 Device shall automatically detect all networked devices connected to it.
- .9 Device shall have an internal time clock used for astronomical and standard schedules.
- .10 Device shall have 2 switched RJ-45 10/100 BaseT Ethernet ports for local area network (LAN) connection.

- .1 Ethernet connection shall support daisy chain wiring to other lighting control system LAN devices.
- .2 Ethernet connection shall support IPv4 and shall be capable of using a dedicated static or DHCP assigned IP address.
- .11 Device shall have 2 x USB 2.0 Expansion ports for 802.11 Wi-Fi Adapter enabling wireless connectivity including:
  - .1 Hot Spot
  - .2 Access Point
  - .3 Client
- .12 Each System Controller shall be capable of managing and operating at least 750 networked devices.
  - .1 Multiple System Controllers may be networked together via LAN connection to scale the system up to 20,000 networked devices.
- .13 System Controller shall support BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
  - .1 BACnet MS/TP shall support 9600 to 115200 baud rate.
  - .2 System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
- .14 System controller shall contain a “FIPS 140-2 Level 1 Inside” cryptographic module.
- .15 System controller shall support RESTful API control of BACnet objects, user management, date and time, and file management.
- .16 System controller shall be available within a NEMA 1 enclosure with Class 1 and Class 2 separation
  - .1 Enclosure shall support power input power of 120-277VAC, or optional 347

## 2.5 Wired Networked Devices

- .1 Wired Networked Wall Switches, Dimmers, Scene Controllers
  - .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
  - .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
  - .3 All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
  - .4 Devices with mechanical push-buttons shall provide tactile and LED user feedback.
  - .5 Devices with mechanical push-buttons shall be made available with custom button labeling.

- .6 Wall switches & dimmers shall support the following device options:
  - .1 Number of control zones: 1, 2 or 4
  - .2 Control Types Supported:
    - .1 On/Off
    - .2 On/Off/Dimming
    - .3 On/Off/Dimming/Correlated Color Temperature Control for specific luminaire types
  - .3 Colors: Ivory, White, Light Almond, Gray, Black, Red
- .7 Scene controllers shall support the following device options:
  - .1 Number of scenes: 1, 2 or 4
  - .2 Control Types Supported:
    - .1 On/Off
    - .2 On/Off/Dimming
    - .3 Preset Level Scene Type
    - .4 On/Off/Dimming/Preset Level for Correlated Color Temperature
    - .5 Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.
    - .6 Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.
  - .3 Colors: Ivory, White, Light Almond, Gray, Black, Red
- .2 Wired Networked Graphic Wall Stations
  - .1 Device shall surface mount to single-gang switch box.
  - .2 Device shall have a 3.5", capacitive full color touch screen.
  - .3 Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
  - .4 Device shall have a micro-USB style connector for local computer connectivity.
  - .5
  - .6 Communication shall be over standard low voltage network cabling with RJ-45 connectors.

- .7 Device shall enable user supplied screen saver image to be uploaded within one of the following formats: jpg, png, gif, bmp, tif.
- .8 Device shall enable configuration of all switches, dimmers, control zones, and lighting preset scenes via password protected setup screens.
- .9 Graphic wall stations shall support the following device options:
  - .1 Number of control zones: Up to 16
  - .2 Number of scenes: Up to 16
  - .3 Profile type scene duration: User configurable from 5 minutes to 12 hours
  - .4 Colors: White, Black
- .3 Wired Networked Digital Key Switches
  - .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
  - .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
  - .3 All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
  - .4 Devices shall have LED user feedback to provide indication of on/off status of the programmed lights or scene, as well as indication of device power.
  - .5 Digital key switches shall support the following device options:
    - .1 Control Types Supported:
      - .1 On/Off
      - .2 On/Off/Dimming
      - .3 Preset Level Scene Type
      - .4 Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.
      - .5 Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones. This shall support manual start/stop from the scene controller, or optionally programmed to automatically end after a user selectable duration between 5 minutes and 12 hours.
    - .2 Colors: Ivory, White, Light Almond, Stainless Steel
- .4 Wired Networked Auxiliary Input / Output (I/O) Devices
  - .1 Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a 1/2" knockout.



- .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
- .3 Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
  - .1 Contact closure or Pull High input
    - .1 Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, activate lights at a preconfigured level, ramp light level up or down, or toggle lights on/off.
    - .2 0-10V analog input
      - .1 Input shall be programmable to function as a daylight sensor.
    - .3 RS-232/RS-485 digital input
      - .1 Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
    - .4 0-10V dimming control output, capable of sinking up to 20mA of current
      - .1 Output shall be programmable to support all standard sequence of operations supported by system.
    - .5 Digital control output via EldoLED LEDcode communication
      - .1 Output shall be programmable to support light intensity control, as well as optional correlated color temperature (CCT) control, of the connected luminaire.
  - .5 Wired Networked Occupancy and Photosensors
    - .1 Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
    - .2 Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
    - .3 For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
    - .4 Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.

- .5 All sensing technologies shall be acoustically passive, meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
  - .6 System shall have ceiling, fixture, recessed & corner mounted sensors available, with multiple lens options available customized for specific applications.
  - .7 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
  - .8 All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
  - .9 Sensor programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
  - .10 Ceiling mount occupancy sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
  - .11 Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
  - .12 Sensors shall have optional features for photosensor/daylight override, automatic dimming control, and low temperature/high humidity operation.
  - .13 Photosensor shall provide for an on/off set-point, and a dead band to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
  - .14 Photosensor and dimming sensor’s set-point and dead band shall be automatically calibrated through the sensor’s microprocessor by initiating an “Automatic Set-point Programming” procedure. Min and max dim settings as well as set-point may be manually entered.
  - .15 Dead band setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
  - .16 A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The secondary daylight zone shall be capable of being controlled as an “offset” from the primary zone.
- .6 Wired Networked Wall Switch Sensors
- .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
  - .2 Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
  - .3 All wall switch sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
  - .4 Devices with mechanical push-buttons shall provide tactile user feedback.

- .5 Wall switches sensors shall support the following device options:
  - .1 User Input Control Types Supported: On/Off or On/Off/Dimming
  - .2 Occupancy Sensing Technology: PIR only or Dual Tech acoustic
  - .3 Daylight Sensing Option: Inhibit Photosensor
  - .4 Colors: Ivory, White, Light Almond, Gray, Black, Red
- .7 Wired Networked Embedded Sensors
  - .1 Network system shall have embedded sensors consisting of occupancy sensors and/or dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
  - .2 Occupancy sensor detection pattern shall be suitable for 7.5' to 20' mounting heights.
  - .3 Embedded sensors shall support the following device options:
    - .1 Occupancy Sensing technology: PIR only or Dual Tech acoustic
    - .2 Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor
- .8 Wired Networked Power Packs and Secondary Packs
  - .1 Power Packs shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
  - .2 Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC) and carry a plenum rating.
  - .3 Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power.
  - .4 Power Supplies shall provide system power only, but are not required to switch line voltage circuit.
  - .5 Auxiliary Relay Packs shall switch low voltage circuits only, capable of switching 1 amp at 40 VAC/VDC (resistive only).
  - .6 Communication shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors. Secondary packs shall receive low voltage power via standard low voltage network cable.
  - .7 Power Pack programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
  - .8 Power Pack shall securely mount through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast/driver channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

- .9 When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- .10 Power/Secondary Packs shall be available with the following options:
  - .1 Power Pack capable of full 16-Amp switching of all normal power lighting load types, with optional 0-10V dimming output capable of up to 100mA of sink current.
  - .2 Secondary Pack with UL924 listing for switching of full 16-Amp Emergency Power circuits, with optional 0-10V dimming output capable of up to 100mA of sink current.
  - .3 Power and Secondary Packs capable of full 20-Amp switching of general purpose receptacle (plug-load) control.
  - .4 Secondary Pack capable of full 16-Amp switching of all normal power lighting load types.
  - .5 Secondary Pack capable of 5-Amps switching and dimming 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
  - .6 Secondary Pack capable of 5-Amps switching and dimming of 120/277 VAC magnetic low voltage transformers.
  - .7 Secondary Pack capable of 4-Amps switching and dimming of 120 VAC electronic low voltage transformers.
  - .8 Secondary Pack capable of louver/damper motor control for skylights.
  - .9 Secondary Pack capable of providing a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
  - .10 Secondary Pack capable of switching 1 amp at 40 VAC/VDC (resistive only) with the intent to provide relay signal to auxiliary system (e.g. BMS).
  - .11 Power Supply capable of providing auxiliary bus power (no switched or dimmed load).
- .9 Wired Networked Luminaires
  - .1 Networked luminaire shall have a mechanically integrated control device.
  - .2 Networked LED luminaire shall have two RJ-45 ports available (via control device directly or incorporated RJ-45 splitter).
  - .3 Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers).
  - .4 Networked LED luminaire shall provide low voltage power to other networked control devices (excluding EMG and CCT capable versions).
  - .5 System shall be able to turn on/off specific LED luminaires without using a relay, if LED driver supports "sleep mode."

- .6 System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
  - .1 System shall indicate (via a blink warning) when the LED luminaire is no longer able to compensate for lumen depreciation.
- .7 System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
- .8 System shall be able to provide control of network luminaire intensity, in addition to dynamic features, such as grayscale and color accent of specific LED luminaires.
- .10 Wired Networked Relay and Dimming Panel
  - .1 Relay and dimming panel shall be available with 4, 8, 12, 16, 24, 32, 40 or 48 individual relays per panel, with an equal number of individual 0-10V dimming outputs.
  - .2 Optional Field Configurable Relays (FCR) used shall have the following required properties:
    - .1 Configurable in the field to operate with single-, double-, or triple-pole relay groupings.
    - .2 Configurable in the field to operate with normally closed or normally open behavior.
    - .3 Provides visual status of current state and manual override control of each relay.
    - .4 Listed for the following minimum ratings:
      - .1 40A @ 120-480VAC Ballast
      - .2 16A @ 120-277VAC Electronic
      - .3 20A @ 120-277VAC Tungsten
      - .4 20A @ 48VDC Resistive
      - .5 2HP @ 120VAC
      - .6 3HP @ 240-277VAC
      - .7 65kA SCCR @ 480VAC
  - .3 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
  - .4 Relay and dimming outputs shall be individually programmable to support all standard sequence of operations as defined in this specification.
  - .5 Panel shall be UL924 listed for control of emergency lighting circuits.
  - .6 Panel shall power itself from an integrated 120-277 VAC or optional 347VAC supply.
  - .7 Panel shall provide a configurable low-voltage sensor input with the following properties:
    - .1 Configurable to support any of the following input types:
      - .1 Indoor Photocell

- .2 Outdoor Photocell
  - .3 Occupancy Sensor
  - .4 Contact Closure
- .2 Low voltage sensor input shall provide +24VDC power for the sensor so that additional auxiliary power supplies are not required.
  - .3 Sensor input supports all standard sequence of operations as defined in this specification.
- .8 Panel shall provide a contact closure input for each group of 8-relays that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel. This input is intended to provide an interface to alarm systems, fire panels, or BMS system to override the panel.
  - .9 Panel shall supply current limited low voltage power to other networked devices connected via low voltage network cable.
  - .10 Panel shall be available with NEMA 1 rated enclosure with the following mounting and cover options:
    - .1 Surface-mounted for all panel sizes
    - .2 Flush-mounted for up to 16 relay panel sizes
    - .3 Screw-fastened for up to 16 relay panel sizes
    - .4 Hinged cover with keyed lock for all panel sizes
  - .11 Surface-mounted screw cover options for 8 and 16 relay panel sizes shall be plenum rated
  - .12 Panel shall be rated from 0-50C for 8 and 16 enclosure sizes, and 0-45C for 32 and 48 enclosure sizes.
- .11 Wired Networked Bluetooth® Low Energy Programming Device
    - .1 Device shall be plenum rated and be inline wired, screw mountable.
    - .2 Communication and low voltage power shall be delivered to device via standard low voltage network cabling with RJ-45 connectors.
    - .3 Bluetooth Low Energy connection shall allow connection from smartphone application for programming device settings within the local daisy-chain zone (*see list of available settings in section 2.4-System Software Interfaces, Sub-section E*).
      - .1 Device shall provide visual indication of remote Bluetooth connection via LED integrated into device enclosure such that it is visible from all angles while the zone is being programmed.
  - .12 Wired Networked Communication Bridge
    - .1 Device shall surface mount to a standard 4" x 4" square junction box.
    - .2 Device shall have 8 RJ-45 ports for connection to lighting control zones (up to 128 devices per port), additional network bridges, and System Controller.

- .3 Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
- .4 Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply, or powered via low voltage network connections from powered lighting control devices (e.g. power packs).
- .5 Wired Bridge shall be capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

### PART 3 - EXECUTION

#### 3.1 Installation Requirements

##### .1 Installation Procedures and Verification

- .1 The successful bidder shall review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
- .2 The successful bidder shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
- .3 The successful bidder shall be responsible for testing of all low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
  - .1 Wire Map (continuity, pin termination, shorts and open connections, etc.)
  - .2 Length
  - .3 Insertion Loss

##### .2 Coordination with Owner's IT Network Infrastructure

- .1 The successful bidder is required to coordinate with the owner's representative to secure all required network connections to the owner's IT network infrastructure.
  - .1 The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.
  - .2 The bidder shall provide to the manufacturer's representative all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.

##### .3 Documentation and Deliverables

- .1 The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device address barcodes corresponding to locations of installed equipment.
- .2 The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package:

- .1 As-Built floor plan drawings showing device address locations required above. All documentation shall remain legible when reproducing\scanning drawing files for electronic submission.
- .2 As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.
  - .1 CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
    - Titleblock
    - Text- Inclusive of room names and numbers, fixture tags and drawings notes
    - Fixture wiring and homeruns
    - Control devices
    - Hatching or poché of light fixtures or architectural elements
  - .2 CAD files shall be of AutoCAD 2013 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2013.

### 3.2 System Startup

- .1 Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed.
  - .1 For CAT5 wired devices, low voltage network cable testing shall be performed prior to system startup.
- .2 System start-up and programming shall include:
  - .1 Verifying operational communication to all system devices.
  - .2 Programming the network devices into functional control zones to meet the required sequence of operation.
  - .3 Programming and verifying all sequence of operations.
- .3 Initial start-up and programming is to occur on-site.

### 3.3 Project Turnover

- .1 System Documentation
  - .1 Submit software database file with desired device labels and notes completed. Changes to this file will not be made by the factory.
  - .2 Installing contractor to grant access to the owner for the programming database, if requested.
- .2 Owner Training
  - .1 Provisions for onsite training for owner and designated attendees to be included in submittal package.

END OF SECTION



**SECTION 262200 - LOW-VOLTAGE TRANSFORMERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

**1.3 SUBMITTALS**

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Source quality-control test reports.
- D. Operation and Maintenance Data: For transformers to include in operation, and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transformer must be stored in a clean and dry location at all times during construction.

## 1.6 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 2. General Electric Company.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; Schneider Electric.

## 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: **Copper**.

## 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section on "Basic Electrical Materials and Methods "
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 2.
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

- E. Taps for Transformers Smaller Than 3 kVA: None.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
  - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
  - 2. Tested according to NEMA TP 2.
- J. Wall Brackets: Manufacturer's standard brackets.
- K. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- L. Low-Sound-Level Requirements: Maximum sound levels, refer to factory values, must comply with IEEE C57.12.91.

#### 2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each **buck-boost** transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section on "Electrical Identification."

#### 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

- D. Verify that ground connections are in place and requirements in Section on "Grounding and Bonding" have been met.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Brace wall-mounting transformers as specified in Section on "Basic Electrical Materials and Methods."
- B. Transformers are to be mounted on a 4" concrete house-keeping pad.
- C. Transformers are to be isolated from concrete pad by a neoprene isolation pad under each leg of the transformer.

### 3.3 CONNECTIONS

- A. Ground equipment according to Section on "Grounding and Bonding."
- B. Connect wiring according to Section on "Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
  - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  - 2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
  - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

**3.5 ADJUSTING**

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

**3.6 CLEANING**

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200



## SECTION 262416 - PANELBOARDS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

## 1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protection Device.

## 1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include wiring diagrams for power, signal, and control wiring.
  - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- C. Qualification Data: For qualified testing agency.

- D. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section on "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.



## 1.7 PROJECT CONDITIONS

## A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Ambient Temperature: Not exceeding **23 deg F (minus 5 deg C)** to plus 104 deg F (plus 40 deg C).
  - b. Altitude: Not exceeding 5000 feet.

## B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 5000 feet.

## 1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

## PART 2 - PRODUCTS

## 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26.

- B. Enclosures: Flush- and surface-mounted cabinets – see panel schedules.
1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. **DOOR-IN-DOOR COVER WITH TWO LATCHES:** Entire front trim hinged to box and with a second hinge to access terminations. A front hinged to box panel with one latch is NOT acceptable. There shall be two sets of hinges, one to access breakers only (dead-front design) and one to access terminations. Each hinge shall have a lockable latch (one minimum per hinge) to access that portion of the electrical panel.
  4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  6. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Same finish as panels and trim.
  7. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top or bottom as required.
- D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: **Hard-drawn copper, 98 percent conductivity.**
  2. Main and Neutral Lugs: **Mechanical** type.
  3. Ground Lugs and Bus-Configured Terminators: **Mechanical** type.
  4. Feed-Through Lugs: **Mechanical** type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

- H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Series rated devices are NOT allowed.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- J. When two-section panelboards are used, BOTH SECTIONS must be the same physical size.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following:**
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Provide door-in-door configuration.
  - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Main Lugs only – see panel schedules.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric..
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or Main Lugs only.

- D. Branch Overcurrent Protective Devices: **Bolt-on** circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike. Provide door-in-door type.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

#### 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
  - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  - 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  - 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  - 8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Shunt Trip: 120 or 24 -V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

## 2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Install panelboards and accessories according to **NEMA PB 1.1**.
- B. Comply with mounting and anchoring requirements specified in Section on "Basic Electrical Materials and Methods."
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.

## 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section on "Basic Electrical Materials and Methods."
- B. Create a directory to indicate installed circuit loads **after balancing panelboard loads**; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section on "Basic Electrical Materials and Methods."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26.

## 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as required by the Engineer.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### 3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

### 3.7 THERMAL SCANS OF ELECTRICAL PANELS

The contractor shall employ a 3<sup>rd</sup> party contractor to performed a thermographic survey on the project. The IR Scan shall be performed by an experienced technician using a Mikron TH5104 Thermal Imaging Camera or approved equal. During the scan excessive temperature rises, if any, shall be identified. Abnormal heat differences with respect to a similar device or an adjacent phase(s) shall be recorded. Thermograms and digital images shall be included in a report to the engineer. The probable cause(s) of the temperature rise and recommended corrective action(s) shall be included for each set of images. When scheduling repairs, remember that heating problems worsen by increases in ambient temperatures and loading. An index of equipment scanned shall be included in the report to the engineer. This serves as a checklist for the scope of work performed.

END OF SECTION 262416





**SECTION 262726 - WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Twist-locking receptacles.
  - 3. Isolated-ground receptacles.
  - 4. Wall-switches.
  - 5. Communications outlets.

**1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. SPD: Surge Protection Device.
- F. UTP: Unshielded twisted pair.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

**1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

**1.6 COORDINATION**

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.
  - 2. It shall be the contractor's responsibility to coordinate the correct male or female connections – provide accordingly.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

**2.2 STRAIGHT BLADE RECEPTACLES**

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5351 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Hubbell; CR 5253IG.
  - b. Leviton; 5362-IG.
  - c. Pass & Seymour; IG6300.
2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

### 2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; GF20.
    - b. Pass & Seymour; 2084.
- C. Isolated-Ground, Duplex Convenience Receptacles:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; IG5362BLS.
    - b. Hubbell; IG5362SA.
    - c. Leviton; 5380-IG.
  2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

### 2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; L520R.
    - b. Hubbell; HBL2310.
    - c. Leviton; 2310.

- d. Pass & Seymour; L520-R.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hubbell; IG2310.
    - b. Leviton; 2310-IG.
  - 2. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

## 2.5 SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

## 2.6 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
- 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Satin-finished stainless steel 0.04-inch- (1-mm-) thick.
  - 3. Material for Unfinished Spaces: Galvanized steel
  - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

## 2.7 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
- 1. Wiring Devices Connected to Normal Power System: As selected by Architect.

2. Wiring Devices Connected to essential electrical system: Red or as selected by Architect – coordinate prior to ordering.
3. Isolated-Ground Receptacles: Orange, with green triangle on face.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pig-tailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
  1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
  2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Tighten unused terminal screws on the device.
7. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
8. Provide a minimum of one wrap of electrical tape around electrical connections.

E. Backbox Mounting:

1. Mount backbox to telescoping screw-gun bracket that extends from stud to stud.
2. Bracket equal to Erico. Contractor to determine size and width.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles **UP**, and on horizontally mounted receptacles to the **LEFT**.

G. Device Plates: Use medium size device plated. Repair wall finishes and remount outlet boxes when device plates do not fit flush or do not cover rough wall opening.

H. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

J. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### 3.2 IDENTIFICATION

A. Comply with Section on "Basic Electrical Materials and Methods."

1. Receptacles: Identify panelboard and circuit number from which served. See drawings for detail.

### 3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Use receptacle tested that shows ground, neutral and proper connectivity.

- B. Tests for Convenience Receptacles – to be performed by the contractor provide report in O&M manuals:
1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of over 5 percent is not acceptable and the conductor must be changed to the next larger size.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726





**SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Enclosed circuit breakers.
  - 2. Fusible switches.
  - 3. Non-fusible switches.
  - 4. Shunt trip switches.
  - 5. Molded-case circuit breakers (MCCBs).
  - 6. Enclosures.

**1.3 DEFINITIONS**

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

**1.4 SUBMITTALS**

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of NRTL listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

- C. Qualification Data: For qualified testing agency.
- D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section on "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single or Double Throw: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses as required for load served, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit (if required): Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Accessory Control Power Voltage: Remote mounted and powered as required.

## 2.2 NON-FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limit to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single or Double Throw: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Lugs: **Mechanical** type, suitable for number, size, and conductor material.

## 2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following:**
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- F. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- G. Use HACR type breakers to serve all outdoor mechanical equipment.
- H. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

## 2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section on "Basic Electrical Materials and Methods."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Section on "Basic Electrical Materials and Methods."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

**SECTION 263323 - CENTRAL BATTERY EQUIPMENT FOR EMERGENCY LIGHTING**

**PART 1- GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Interruptible (fast-transfer) central battery equipment.
  - 2. Enclosures.
  - 3. Optional and accessory features.
- B. Related Requirements:

**1.03 DEFINITIONS**

- A. DDC: Direct digital control.
- B. IBC: International Building Code.
- C. Interruptible: As used in the Section Text, an off-line, passive-standby or line-interactive, inverter-only unit, with an intentional interruption of power to the load until an internal transfer switch picks up and transfers the load to the unit's inverter and internal battery source on loss of the "normal" source, and then retransfers to the "normal" source when it is restored. Transfer time to be "fast" (2-4 ms or 40-50 ms, depending on manufacturer).
- D. LED: Light-emitting diode.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- F. OCPD: Overcurrent protective device.
- G. PWM: Pulse-width modulated.
- H. TDD: Total demand (harmonic current) distortion (also listed as "THD" in catalog data by manufacturers).
- I. THD(V): Total harmonic voltage demand.
- J. Uninterruptible: As used in the Section Text, an on-line, double-conversion (rectifier/inverter) unit, with no interruption of power to the load on interruption and restoration of the "normal" source.
- K. UPS: Uninterruptible power supply.
- L. VRLA: Valve-regulated lead acid.

**1.04 SUBMITTALS**

- A. Product Data: For each type and rating of central battery equipment unit.
  - 1. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, shipping splits, and furnished options, specialties, and accessories.
- B. Shop Drawings: For each type and rating of central battery equipment unit.
  - 1. Include plans, elevations, sections, and mounting details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, components, and location and size of each field connection.
3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.
4. Include elevation, details, and legends of control and indication displays.
5. Include -circuit current (withstand) rating of unit.

- C. Qualification Data: For Installer and testing agency.
- D. Product Certificates: For each type of central battery equipment.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For central battery equipment to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing central battery equipment.
    - b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
    - c. Manufacturer's written instructions for selecting and setting field-adjustable controls and status and alarm points

**1.06 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
  1. Output Circuit Breakers: One for every 10 of each type and rating, but no fewer than 1 of each type.
  2. Cabinet Ventilation Filters: One complete set.

**1.07 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in fully enclosed vehicles.
- B. Store equipment in spaces having environments controlled within manufacturers' written instructions for ambient temperature and humidity conditions for non-operating equipment.

**1.09 FIELD CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
  2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
  3. Humidity: More than 95 percent (condensing).
  4. Altitude: Exceeding 3300 feet (1000 m).



- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for central battery equipment, including clearances between central battery equipment and adjacent surfaces and other items.

**1.10 COORDINATION**

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

**1.11 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace central battery equipment that fails in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.
  - 1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
    - a. Central Battery Equipment (excluding Batteries): 2 year(s).
    - b. VRLA Batteries:
      - 1) Full Warranty: 1 year.
      - 2) Pro Rata: 9 years.

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Central battery equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated central battery equipment shall be tested and certified by an NRTL as meeting ICC-ES AC 156 test procedure requirements.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

**2.02 INTERRUPTIBLE (FAST-TRANSFER) CENTRAL BATTERY EQUIPMENT**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Isolite
  - 2. Or equal
- B. General Requirements for Interruptible (Fast-Transfer) Central Battery Equipment:
  - 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.
  - 2. NRTL Compliance: Fabricate and label central battery equipment to comply with UL 924.
  - 3. Comply with the IBC, NFPA 70, and NFPA 101.
  - 4. Comply with NEMA PE 1.
- C. Performance Requirements:
  - 1. Fast-Transfer Central Battery Equipment: Passive standby (off-line) system. Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load. Transfer in 2-4ms or less from normal supply to battery-inverter supply.
  - 2. Automatic Operation:
    - a. Normal Conditions: Supply the load with ac power flowing from normal ac power input terminals, bypassing inverter, with battery connected in parallel via rectifier/charger output.

- b. Abnormal Supply Conditions: If normal ac supply deviates from specified voltage, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
  - c. If normal power fails, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
  - d. If a fault occurs in system when being supplied by inverter and current flows in excess of the overload rating of inverter, inverter automatically protects itself against damage from overloads and short circuits by shutting down.
  - e. When normal ac power is restored at input supply terminals of unit, controls automatically retransfer the load back to the normal ac supply, with a momentary loss of power to the load. Rectifier/charger then recharges battery.
  - f. If normal power failure is prolonged (more than 90 minutes), integral low-voltage battery protective circuit disconnects battery and prevents battery from damage due to deep discharge.
  - g. If battery becomes discharged, and when normal ac supply is again available, rectifier/charger recharges battery. When battery is fully charged, rectifier/charger automatically shifts to float-charge mode.
  - h. If battery is disconnected, and normal ac power is available, central battery equipment continues to supply power to the load with no degradation of its regulation of voltage and frequency of output bus.
- D. Unit Operating Requirements:
- 1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of central battery equipment input voltage rating.
  - 2. Input Frequency Tolerance: Plus or minus 3 percent of central battery equipment frequency rating.
  - 3. Synchronizing Slew Rate: 1 Hz per second, maximum.
  - 4. Minimum Off-Line Efficiency: 95 percent at 60 Hz, full load.
  - 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or operating condition.
  - 6. Ambient Temperature Rating (Other Than Batteries): Not less than 68 deg F (20 deg C) and not exceeding 86 deg F (30 deg C).
  - 7. Ambient Storage Temperature Rating (Other Than Batteries): Not less than minus 4 deg F (minus 20 deg C) and not exceeding 158 deg F (70 deg C).
  - 8. Ambient Temperature Rating (Batteries): Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
  - 9. Ambient Storage Temperature Rating (Batteries): Not less than 0 deg F (minus 18 deg C) and not exceeding 104 deg F (40 deg C).
  - 10. Humidity Rating: Less than 95 percent (noncondensing).
  - 11. Altitude Rating: Not exceeding 3300 feet (1005 m).
  - 12. Off-Line Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
- E. Inverter and Controls Logic: Microprocessor based, isolated from all power circuits; provides complete self-diagnostics, periodic automatic testing and reporting; with alarms.
- F. Controls and Indication:
- 1. Status Indication: Door-mounted, labeled LED indicators or digital screen displaying the following conditions:
    - a. Normal power available.

- b. Status of system.
  - c. Battery charging status.
  - d. On battery power.
  - e. System fault.
  - f. External fault.
2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
- a. Keypad: In addition to required programming and control keys, include the following:
    - 1) Keys for METER, CONTROL, PROGRAM, and CLEAR modes.
    - 2) Security Access: Provide electronic security access to controls through identification and password with at least two levels of access: View only; and view, operate, and service.
    - 3) Control Authority: Supports at least three conditions: Off, local manual control at unit and local automatic control at unit.
  - b. Digital Display: Plain-English language messages on a digital display; provide the following historical logging information and displays:
    - 1) Real-time clock with current time and date.
    - 2) Tests and Events Logs: Record and store up to 25 tests and events.
      - a) Dates.
      - b) Times.
      - c) Durations.
      - d) Output voltage and currents.
    - 3) Alarm Logs: Record and store up to 25 alarms.
      - a) Dates.
      - b) Times.
      - c) Alarm type.
    - 4) Metering Functions: Display central battery equipment metering parameters including, but not limited to, the following:
      - a) Input and output voltage (V ac) and output current (A ac).
      - b) Battery voltage (V dc) and current (A ac).
      - c) Fault or alarming status (code).
      - d) Power output (VA).
      - e) Inverter load (W).
      - f) Ambient temperature (deg F).
      - g) System run time (cumulative days).
      - h) Inverter run time (cumulative minutes).
    - 5) Alarm Functions: Digital display mounted flush in unit door and connected to display central battery equipment parameters including, but not limited to, the following:
      - a) High/low battery charge voltage.
      - b) High/low input voltage.
      - c) Battery nearing low-voltage condition.
      - d) Battery low voltage.
      - e) High ambient temperature.
      - f) Inverter fault.

- g) Output fault.
  - h) Output overload.
3. Remote Signal Interfaces:
- a. Remote Indication Interface: A minimum of one programmable (Form C) dry-circuit relay output(s) (120-V ac, 2 A) for remote indication of the following:
    - 1) Fault or status indication.
    - 2) On bypass.
    - 3) Low battery.
  - b. Communications Interface: Factory-installed hardware and software to enable a remote PC to program central battery equipment and monitor and display status and alarms.
    - 1) Network Communications Ports: Ethernet
    - 2) Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via DDC system for HVAC RS-485 serial networks and Ethernet 10Base-T networks as a native device.
- G. Self-Protection and Reliability Features:
- 1. Input transient protection by means of surge suppressors to provide protection against damage from supply voltage surges as defined in IEEE C62.45, Category B and C.
  - 2. Integral, programmable, self-diagnostic and self-test circuitry; with alarms and logging.
  - 3. Battery deep-discharge and self-discharge protection; with alarms.
  - 4. Battery self-test circuitry; with alarms and logging.
- H. Integral Input Disconnecting Means and OCPD: Thermal-magnetic circuit breaker
- 1. Integrated Equipment Minimum Short-Circuit Current (Withstand) Rating: as noted on the Electrical Riser
- I. Inverter:
- 1. Description: Solid-state, high-frequency, PWM type, with the following operational features:
    - a. Automatically regulate output voltage to within plus or minus 3 percent, for all load ranges and for maximum 25 percent step-load changes; regulation may increase to 8 percent for 100 percent step-load changes.
    - b. Automatically regulate output frequency to within plus or minus 1 Hz, from no load to full load, at unity power factor, over the operating range of battery voltage.
    - c. Output Voltage Waveform: Sine wave with maximum 3 percent TDD throughout battery operating-voltage range, for 100 percent linear load.
    - d. Inverter Overload Capability: 115 percent for 10 minutes; 150 percent surge for 10 seconds.
    - e. Load Power Factor: 0.5 lead to 0.5 lag.
    - f. Brownout Protection: Produces rated power without draining batteries when input voltage is down to 75 percent of normal.
- J. Rectifier/Battery Charger:
- 1. Description: Solid state, variable rate, temperature compensated; automatically maintains batteries in fully charged condition when normal power is available.
  - 2. Maximum Battery Recharge Time from Fully Discharged State: 24 hours.

3. Low-voltage disconnect circuit reduces battery discharge during extended power outages, monitors battery voltage, and disconnects inverter when battery voltage drops to no less than 85.7 percent of nominal voltage.

K. Batteries:

1. Description: VRLA batteries.
  - a. Capable of sustaining full-capacity output of inverter unit for minimum of 90 minutes.
2. Battery Disconnect and OCPD: Manufacturer's standard.

L. Maintenance Bypass Systems:

1. Maintenance Bypass Mode:
  - a. Internal; manual operation only; bypasses central battery equipment power circuits (inverter and static transfer switch); requires local operator selection at central battery equipment. Transfer and retransfer shall be make-before-break, without disrupting power to the load or causing system instabilities.
  - b. External; manual operation only; bypasses central battery equipment completely; requires local operator selection at external switch enclosure remote from central battery equipment. Transfer and retransfer shall be make-before-break, without disrupting power to the load or causing system instabilities.
2. Bypass Overload Capability: 1.5 times the base load current.

M. Integral Output Disconnecting Means and OCPD:

1. Single-Output OCPD: As scheduled on Drawings; manufacturer's standard ratings based on unit output ratings.
2. Multiple-Output OCPDs: Thermal-magnetic circuit breakers, complying with UL 489; voltage rating matching unit output voltage rating; 20 A, single pole.
  - a. Normally Closed: as noted on the Drawings.
  - b. Normally Open: as noted on the Drawings.

## 2.03 ENCLOSURES

A. Central Battery Equipment Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1 steel cabinets with access to components through hinged doors with flush tumbler lock and latch.
2. Finish: Manufacturer's standard baked-enamel finish over corrosion-resistant prime treatment

## 2.04 OPTIONAL AND ACCESSORY FEATURES

A. Factory-Installed Options and Accessories:

1. Multiple-Output Voltages: Supply unit branch circuits at different voltage levels if required. Transform voltages internally as required to produce indicated output voltages.
2. Split-Output Configuration: Divides output into normally on and normally off buses.
3. Audible alarm with silencer switch.
4. Remote Summary Annunciator Panel: Labeled LEDs on panel faceplate shall indicate five basic status conditions. Audible signal indicates alarm conditions; silencing switch in face of panel silences signal without altering visual indication.
  - a. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

**2.05 SOURCE QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to evaluate central battery equipment fabricator's quality-control and testing methods.
- B. Testing: Test and inspect central battery equipment according to UL 924.
- C. Factory Tests: Test and inspect assembled central battery equipment according to UL 924. Affix standards organization's label. Include the following:
  - 1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
  - 2. Full-load test.
  - 3. Transient-load response test.
  - 4. Overload test.
  - 5. Power failure test.
- D. Central battery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

- A. Receive, inspect, handle, and store central battery equipment according to NECA 411.
- B. Examine areas, surfaces, and substrates to receive central battery equipment, with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.
- C. Examine equipment before installation. Reject equipment that is wet, moisture damaged, or mold damaged.
- D. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

- A. Coordinate layout and installation of central battery equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install central battery equipment and accessories according to NECA 411.
- C. Floor-Mounted Central Battery Equipment: Install central battery equipment on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.

- D. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- F. Comply with NECA 1.
- G. Wiring Methods:
  - 1. Install cables in raceways.
  - 2. Conceal raceway in all locations.
  - 3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.03 CONNECTIONS

- A. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.04 INSTALLATION OF CONTROL WIRING

- A. Install wiring between central battery equipment and remote devices.
- B. Bundle, train, and support wiring in enclosures.

### 3.05 IDENTIFICATION

- A. Identify central battery equipment, components, and control wiring. Comply with requirements for identification specified in Section on "Basic Electrical Materials and Methods."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label central battery equipment with engraved nameplates.
  - 3. Label each separate cabinet, for multi-cabinet units.
  - 4. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for central battery equipment, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of central battery equipment units.

### 3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Acceptance Testing Preparation:
  - 1. Inspect and Test Each Component:
    - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
    - b. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.

- c. Test continuity of each circuit.
- E. Tests and Inspections:
1. Inspect central battery equipment, wiring, components, connections, and equipment installation.
  2. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
  3. Test continuity of each circuit.
  4. Verify that input voltages and frequencies at central battery equipment locations are within voltage and frequency limits specified in Part 2. If outside this range, notify Engineer before closing input OCPDs.
  5. Perform each visual and mechanical inspection and electrical test stated in manufacturer's written instructions and in NETA Acceptance Testing Specification, including specifically those for batteries, battery chargers, and UPS, regardless of the type of central battery equipment provided. Certify compliance with test parameters.
  6. Perform a load-duration test at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Monitor and record ambient temperature and temperatures within the unit.
  7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of central battery equipment. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of central battery equipment 11 months after date of Substantial Completion.
    - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Central battery equipment will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies central battery equipment and describes all test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

### 3.07 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.

### 3.08 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, and other adjustable parts.
- C. Adjust the trip settings of thermal-magnetic circuit breakers with adjustable, instantaneous-trip elements; install fuses if not factory installed.



- D. Set the automatic system test parameters.

**3.09 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace central battery equipment whose interiors have been exposed to water or other liquids prior to Substantial Completion.

**3.10 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central battery equipment, and to use and reprogram microprocessor-based control, monitoring, and display functions.

**END OF SECTION 263323**



**SECTION 265100 - INTERIOR LIGHTING**

**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. Section Includes:
  - 1. Interior lighting fixtures.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Lighting fixture supports.
  - 5. Retrofit kits for fluorescent lighting fixtures.
- B. Related Sections:
  - 1. Division 26 Section "Wiring Devices".
  - 2. Division 26 Section "Lighting Controls".

**1.3 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. LED: Light Emitting Diode
- G. CCT: Correlated Color Temperature
- H. CRI: Color-rendering Index
- I. Lumen: Measured output of lamp and luminaire, or both.

## 1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
  2. Emergency lighting units including battery and charger.
  3. Energy-efficiency data.
  4. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Submittals" Article in Mechanical Division on Section "Diffusers, Registers, and Grilles."
  5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
  6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Wiring Diagrams: For power, signal, and control wiring.
- C. Installation instructions.
- D. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting fixtures.
  2. **Grid type and mounting system – provide based on type of grid provided by the Architect – narrow grid may take special parts / frames installed by the factory on some fixtures. Clips that allow a gap around the fixture is NOT acceptable and will be rejected if installed in the field.**
  3. Suspended ceiling components.
  4. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.
  5. Ceiling-mounted projectors.
  6. Structural members to which suspension systems for lighting fixtures will be attached.
  7. Other items in finished ceiling including the following:

- a. Air outlets and inlets.
  - b. Speakers.
  - c. Sprinklers.
  - d. Smoke and fire detectors.
  - e. Occupancy sensors.
  - f. Access panels.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
- G. Warranty: Sample of special warranty.

#### 1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. LED Fixtures:
1. UL and/or ETL Listed
  2. All light fixture components shall be IESNA LM-79-2008 Rated
  3. All LEDs shall be IESNA LM-80-2008 Rated interpreted per IESNA TM-21.
  4. EnergyStar Compliant – When Specified
  4. DLC (DesignLights Consortium) Qualified – When Specified
  5. Lighting Facts Listed – When Specified

#### 1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

#### 1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 5 years from date of Substantial Completion. The first year will include parts and labor. After the first year this shall include material only.

**B. Warranty for Lighting Fixtures:**

1. **LED Drivers shall provide a written 5-year on-site replacement warranty for defective or non-starting power supply units and LED source assemblies, which include, but are not limited to, LED packages, LED arrays, LED modules, LED dies, encapsulates, and phosphors.**
  - a. **LEDs shall be minimally rated at L80 unless otherwise specified.**
  - b. **Interior Fixtures including the LED Driver, LED Array and all associated components shall be minimally rated for 50,000 hours.**

1.8 (EDIT) EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Provide quantity of each fixture type as indicated below:
  1. **Fixture Type (#) - Quantity**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, **provide product indicated on Drawings in the Lighting Fixture Schedule – OR as approved equal.**

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. LED Fixtures:
  1. Submitted light fixtures shall match specified drive current and lumen output.
  2. Submitted light fixture CRI shall be equal to or greater than the CRI specified.
  3. Binning: Per ANSI, 3-step MacAdam Ellipse or greater
  4. Fixtures shall offer 0-10V dimming or digitally addressable driver: Specified lighting control manufacturer shall serve as a basis of design on a per project basis.
  5. Housing, LED driver, and LED module shall be provided by the same manufacturer.
  6. Photometric data shall be included for all fixtures.
  7. Interior calculations, when requested, shall include all summary data including uniformity ratios.
- B. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- F. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least **0.125 inch (3.175 mm) – 8 oz per sqft.**
    - b. UV stabilized.
- G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. CCT and CRI for all luminaires.

### 2.3 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. For AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
  - 3. Master/Remote Sign Configurations:

- a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply ballast for power connection to remote unit.
  - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.
- C. Provide universal mounting hardware for all exit signs

## 2.4 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
  7. Integral Time-Delay Relay: Holds unit on for fixed interval of [15] minutes when power is restored after an outage.
  8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, **12 gauge**.



- E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Ceiling types used and coordination with lighting fixtures specified shall be done by the contractor prior to ordering fixtures. Provide all the necessary parts, frames, brackets and related items needed for the fixtures specified to mount in the type of ceiling specified by the Architect. This includes, but is not limited to: frames, brackets, and other items needed for gypsum board, lay-in (normal and narrow grid type). There shall be no light leaks or open space between the fixture and frame or grid. This could result in fixtures having to be replaced at contractor's expense, if this isn't done. No change order will be issued for this item.
- C. Provide #14 AWG conductor in fixture whips.
- D. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- E. Remote Mounting of Drivers: Distance between the driver and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- F. Lay-in Ceiling Lighting Fixtures Supports: Do not use grid as a support element.
  - 1. Install ceiling support system rods or wires, **independent of the ceiling suspension devices**, for each fixture (1 at each corner of fixture, 4 total per fixture).
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
  - 5. **The contractor shall pay close attention to the type of lay-in ceiling grid that is specified by the Architect and provide fixtures that will match and be compatible with the grid. This may take a special frame for the fixtures. The fixtures MUST fit the grid without any gaps around the fixture. No change orders will be processed.**

## G. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

## H. Connect wiring according to Division 26 Section "Conductors and Cables."

## 3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."

## 3.3 DISPOSAL OF FLUORESCENT FIXTURES

- A. Where demolition and removal of existing fluorescent fixtures is required, the contractor shall properly dispose of all lamps and ballasts. The contractor may visit [earth911.com](http://earth911.com) or similar reference websites to locate the proper, local resource and dispose of as directed.

## 3.4 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

## 3.5 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

## 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
  1. Adjust aimable luminaires in the presence of Architect.

**PROJECT #: 2019048**

**ITAWAMBA COMMUNITY COLLEGE  
FINE ARTS BUILDING RENOVATION**

**FULTON, MS**

END OF SECTION 265100



## SECTION 265561 – THEATRICAL LIGHTING SYSTEM

## PART 1 - GENERAL

## 1.1 WORK INCLUDED

- A. **The work required by this section is to be included as an allowance.** The Electrical Contractor shall include in his bid, an allowance of \$325,000.00 (Three Hundred Twenty-five Thousand Dollars) to procure the Theatrical Lighting Systems described herein and further illustrated on Division 26 drawings. Selection of the appropriate Theatrical Lighting Contractor shall be made on a “Best Value” basis for the Owner once the project has been awarded. The selection process will include representatives of the Owner and Design Professionals.
- B. The Electrical Contractor, as part of the work of this section, shall provide, install and test a complete lighting control system as specified herein for areas indicated on the drawings and circuit schedules.
- C. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware and other incidental items necessary for the complete and proper operation of the lighting control system.
- D. The Electrical Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to:
1. General Conditions
  2. Electrical Section General Provisions
  3. Conduit
  4. Wire and Cable
  5. Stage rigging
- E. Shop Drawing Submittals:
1. Within sixty (60) days of contract award, the Contractor shall submit one (1) copy in PDF format of all shop drawings in PDF format to the General Contractor for approval prior to fabrication:
    - a. Complete, fully dimensioned shop drawings of all major components.
    - b. Plans, sections and schematics indicating assembly and installation of components.
    - c. Load ratings of the major components within the system.
    - d. Any additional structural support supplied and installed by this contractor.
    - e. Specific listing of any and all variations from the Drawings and Specifications.
    - f. Power requirements for any electrical components.
- F. Definitions:
1. TLC: Theatrical Lighting Contractor
  2. TRC: Theatrical Rigging Contractor

## 1.2 SYSTEM DESCRIPTION

- A. The system shall be designed for the control of architectural and theatrical lighting and shall consist of factory pre-wired dimming and processing rack enclosures containing dimmers, power supplies, breakers, terminals and/or control electronics.
- B. System shall work in conjunction with specified low-voltage control stations.

**1.3 SUBMITTALS**

- A. Manufacturer shall provide 1 set of full system submittals in PDF format. Submittals shall include:
  - 1. Full system riser diagram(s) illustrating interconnection of system components, wiring requirements, back box sizes and any special installation considerations.
  - 2. Full set of printed technical data sheets.
  - 3. Detailed set of dimmer schedules.
  - 4. Detailed set of circuit and control schedules, including a complete list of all deviations from specifications.
- B. Manufacturer shall provide any additional information, including equipment demonstration, as required by the engineer or specifier to verify compliance with specifications.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer shall be one who has been continuously engaged in the manufacturer of lighting control equipment for a minimum of ten years. All dimmer and cabinet fabrication must take place in a U.S. manufacturing plant.
- B. Proposed equipment shall be UL and C-UL listed, and/or CE marked (where applicable) and bear the appropriate labels.

**1.5 WARRANTY**

- a. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two years from date of delivery.
- b. Warranty shall cover repair or replacement of such parts determined defective upon inspection.
- c. Warranty does not cover any product or part of a product subject to accident, negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied by the manufacturer.
- d. Warranty shall not cover any labor expended or materials used to repair any equipment without manufacturer's prior written authorization.

**1.6 ACCEPTABLE MANUFACTURERS**

- A. Acceptable manufacturers for this project are:

1. Altman Stage Lighting
  2. Canto USA
  3. Electronic Theatre Controls
  4. The Light Source
  5. Robert Juliat
  6. SSRC
  7. Strand Lighting
- B. Basis-of-Design Product: The design for each lighting product is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified. Alternative manufacturers must submit a full pre-approval package fifteen days prior to bid date. Package shall consist of items listed in Part 1, Section 1.03A.
- C. Permission to bid does not imply acceptance of the manufacturer. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for controls systems that meet or exceed the specifications.

## **PART 2 – PRODUCTS**

### **2.1 LIGHTING CONSOLE AND ACCESSORIES**

#### **A. GENERAL**

1. The lighting control console shall be a microprocessor-based system specifically designed to provide complete control of stage, studio, and entertainment lighting systems. The console shall be the Ion Xe 20 as manufactured by Electronic Theatre Controls, Inc., or equal.
2. The system shall provide control of 2,048 on a maximum of 32,768 control channels, which may be any number from 1 to 99,999. Systems that require external co-processing to control 12,288 outputs shall not be acceptable. Output shall be distributed over a 10/100 MB Ethernet network using Net3/ACN, ETCNet2, Avab and/or Artnet (multi-cast) protocols. The user shall be able to control the application of protocols at an individual address level.
3. 20 45mm faders shall be user configurable across 100 pages and provide additional playback faders (up to 200), additive or inhibitive submasters (up to 999), and grand master control. Associated displays provide content identification. Presets and IFCB palettes may be loaded to faders for playback control, either individually or in user-defined lists. Virtual fader control is also provided.

4. Control and programming features for automated fixtures shall also include: a standard library of fixture profiles, the ability to copy and edit existing profiles and create new profiles, patch displays including channel and output addressing, 16-bit fade resolution, color characterization allowing color mixing in up to six different color spaces.
5. A context sensitive on-line Help feature shall explain and provide an example of the operation of each feature of the system. This help system shall be integrated into the on-board user manual via hyperlinks.
6. A detachable alphanumeric keyboard shall be provided. The keyboard shall allow labeling of all show content. An integrated virtual alphanumeric keyboard shall also be provided.
7. Integrated dimmer monitoring features shall be provided to allow indication of dimming system status, error states and dimmer load monitoring. Adjustment of dimmer configuration from the console shall also be supported. Communications with the dimming system shall utilize ANSI E1.17 2006 - Entertainment Technology - Architecture for Control Networks.
8. Integrated RDM device features shall be provided. The console shall discover and patch RDM devices. The console shall monitor RDM devices to allow indication of RDM device online/offline status error states. The console shall be capable of changing settings of RDM devices such as the DMX start address. Communications with the RDM devices shall utilize ANSI E1.20 2006 – Remote Device Management.
9. Network configuration tools shall be provided from within the desk.
10. Systems that do not provide the above capabilities shall not be acceptable.

**2.2 CONSOLE TOUCH SCREENS.**

- A. Console touch screens shall be a HP EliteDisplay E230t 23-inch Touch Monitor or equal.
- B. General
  1. Display type is IPS w/ LED backlight
  2. Touch screen shall include 1 VGA, 1 HDMI, 1 Display Port, and 3 USB ports.

**2.3 CONSOLE UNINTERRUPTIBLE POWER SUPPLY**

- A. Console Uninterruptible power supply shall be APC Back up with 6 outlets or equal
- B. General
  1. Uninterruptible power supply will have at minimum volt amp capacity of 425
  2. Full load runtime of three minutes
  3. Half load runtime of ten minutes.



## C. Physical

1. Depth: 183mm
2. Height: 300mm
3. Width: 95mm

## 2.4 INTELLIGENT BREAKER SYSTEM

## A. GENERAL

1. Intelligent breaker system shall be Sensor IQ-277V as manufactured by ETC, Inc., or equal
2. Breaker Panels shall be UL508, UL67, and UL924 Listed, and shall be so labeled when delivered
3. Breakers shall be UL489 listed and shall be labeled when delivered
4. Breaker Panels shall consist of a main enclosure with 48 pole breaker subpanels, integral control electronics for low voltage terminations and provision for accessory cards
  - a. Up to two accessory cards shall be supported per breaker panel

## B. Mechanical

1. The panel shall be constructed of 16-gauge galvanized steel. All panel components shall be properly treated or finished in fine-textured, scratch resistant paint
2. 240/277V breaker panels shall be capable of being mounted on the surface of a wall or recessed mounted
3. Breaker panels shall be available in 48 pole configurations
  - 73.00" high, 20.00" wide and 5.11" deep (with front panel attached)
4. Choice of panel covers shall be available for surface or recess mount applications. This outer panel shall ship complete with a locking door to limit access to electronics and breakers
  - a. Optional center-pin reject security screws shall be available for all accessible screws
  - b. Optional recess mount doors shall extend 1" beyond all panel edges to hide wall cut-out
5. The unit shall provide interior cover over the control electronics and accessory cards to allow access only to class 2 wiring and prevent direct access to class 1 line voltage components
6. The panel shall support up to twelve, twenty-four, or 48 single pole branch circuits

- a. Branch circuits shall range from 15A to 20A capable of holding full rated load for minimum of three hours continuously
  7. Breakers shall provide manual switching control while power is unavailable to the panel such that critical lighting can be set to an on state, without the need for power to the panel
  8. Breaker output lugs shall accept 10-14 AWG dual conductor wire
  9. Breaker output lug shall support solid or stranded 6-14 AWG class B, C, or K copper wire
  10. Control wiring for DMX, station bus, and Emergency input terminations shall land on a removable header for contractor installation
- C. User Interface
1. The user interface shall contain an LCD display with button pad to include 0-9 number entry, up, down back arrow navigation and enter
  2. Test shortcut button shall be available for local activation of preset, sequence and set level overrides
  3. The user interface shall have a power status LED indicator (Blue), a DMX status LED indicator (Green), a network status LED indicator (Green) and an LED indicator (red) for errors
  4. Interface shall allow the backlight to timeout and shall provide user editable options to shut off backlight completely as well as adjust screen contrast
  5. Ethernet interface shall default to automatic IP through link local and DHCP. Upon receiving IP address, the address of the Network Interface Card (NIC) shall display in the about menu. Static address and settings shall also be possible
  6. The control interface shall support a USB memory stick interface for uploads of configurations and software updates
  7. The user interface shall support power input from an external Uninterruptible Power Supply (UPS) supplying 800W-2400W AC power
- D. Functional
1. Panel setup shall be user programmable. The control interface shall provide the following breaker setup features (per circuit):
    - a. Type (1 pole, 2 pole, or 3 pole)
    - b. Name
    - c. Circuit Number
    - d. DMX address
    - e. sACN address
    - f. Space Number
    - g. Circuit Modes  
Normal (priority and HTP based activation and dimming)

- Latch-lock
  - Fluorescent
  - DALI
  - h. On threshold level
  - i. Off threshold level
  - j. Include in UL924 emergency activation
  - k. Allow Manual
2. Breaker panels shall support discrete addressing of each breaker. Panels that are restricted to use of start address with sequential addressing, and cannot assign each 0-10V output control to any internal circuit shall not be acceptable
  3. The panel shall be capable of switching 6 poles on or off at once, or in a user-selectable delay per breaker using a period of 0.1 to 60 seconds, in 0.1 second increments
  4. An Ethernet connection shall provide advanced control of relays over streaming ACN (sACN) and transmit status, control override, and measured energy usage per branch circuit via an internal Web UI or central monitoring interface
    - a. Control electronics shall report the following information per branch circuit.
      - 1) Breaker state (On/Off)
      - 2) Breaker state (Open/Closed)
      - 3) Current draw (In Amps)
      - 4) Voltage
      - 5) Energy usage
    - b. Panels that do not report this information shall not be acceptable.
  5. The panel shall receive ESTA DMX512-A control protocol. Addressing shall be set via the user interface button keypad with any circuit patched to any DMX control address
    - a. 2,500V of optical isolation shall be provided between the DMX512 inputs and the control electronics as well as between control and power components
    - b. The breakers shall respond to control changes (DMX or Stations) in less than 25 milliseconds. DMX512 update speed shall be 40Hz
  6. Setting changes shall be able to be made across all, some, or just one selected breaker in a single action from the face panel
  7. DMX data loss shall allow for levels/breakers to be held for ever or for a specified time before switching to a lower priority source
  8. Initial Panel setup
    - 1) The breaker panel shall automatically detect the type of breaker or dimmer installed in each location without need for manual configuration of the physical arrangement

- 2) Quick rack setup shall be available to apply address settings across all circuits for rack number, DMX Start Address, sACN universe, and sACN start address
- 3) Emergency Setup Menu shall provide optional delays when emergency is activated or deactivated, and option to turn off non-emergency circuits shall be available. Record function shall allow circuits that are turned on to be added to the emergency setting

**E. Electrical**

1. Breaker Panels shall be available to support power input from:
  - a. 277/480V, 230/400V and 240/415V three phase. 4-wire plus ground
2. Conduit Entry:
  - a. Feeders:
    - 1) Top or upper 6” of either side
    - 2) Bottom or lower 6” of either side
    - 3) Feeders shall enter through the top or bottom according to the orientation of the enclosure
    - 4) Feeder entry shall be nearest to the location of the feeder lugs or main breaker
  - 2) Load:
    - 1) Load wiring shall enter through the top or bottom of the enclosure through the surface nearest to the breaker sub panel
    - 2) Load wiring may also enter through left and/or right side provided a low voltage chase is not required through the same area. If class 2 chase is required, a field installable barrier panel shall be provided upon request. The side of the panel where the barrier has been installed shall not permit load wiring
  - 3) Low Voltage:
    - 1) Top or upper 6” of either side
    - 2) Bottom or lower 6” of either side
    - 3) For low voltage conduit entry at the breaker end of the cabinet, conduits shall be located at the outer 3” of the top/bottom panel

**F. Breaker remote switching ratings**

1. Mechanical 1,000,000 cycles
2. 16A Resistive 100,000 cycles (with 20A breaker)

3. 12A Resistive 100,000 cycles (with 15A breaker)
4. 16A Ballast (HID) 75,000 cycles
5. 15A Electronic (LED) 100,000 cycles
6. 15A Tungsten 45,000 cycles
7. 30FLA; 180 LRA Motor Load 50,000 cycles
8. Tested duty cycle: 12 operations (6 cycles) per minute
9. Decreasing duty cycle significantly increases switch life
10. Isolation: 4000V RMS
11. Current reporting accuracy: 5%
12. Latching state mechanical relay

#### G. Breaker Panel Accessories

1. A low voltage 0-10V dimming option shall provide up to 24 0-10v control outputs that are linked to relay circuits within the panel. Each output shall support up to 400mA of current sink per output
2. A contact input option shall provide 24 dry contact inputs to be linked for direct or group relay control, to activate a preset, or to activate a sequence. Controller software shall allow for normally
3. Main Fuse and Breaker options shall be available as shown in Section E.4

#### H. Thermal

1. The panel shall be convection cooled. Panels that require the use of cooling fans shall not be acceptable
2. The panel shall operate safely in an environment having an ambient temperature between 32°F (0°C) and 104°F (40°C), and humidity between 5-95% (non-condensing)

### 2.5 UNISON DRD SERIES CONTROL ENCLOSURE

A. The rack enclosure shall be the Unison DRd Series Control Enclosure as manufactured by Electronic Theatre Controls, Inc., or equal.

#### B. Mechanical

1. The Rack Enclosure shall be a surface mounted, deadfront switchboard, constructed of 18-gauge formed steel panels with a hinged, lockable full-height door containing an integral electrostatic air filter.
  - a. Filter shall be removable for easy cleaning.

- b. The enclosure shall support one control processor and one station power module plus accessories
    - c. The enclosure door shall have an opening to allow limited access to the control module face panel.
  2. All rack components shall be properly treated and finished.
    - a. Exterior surfaces shall be finished in fine textured, scratch-resistant, epoxy paint.
  3. The fully digital rack enclosure shall be available with six or twelve dimmer module spaces, one processor and a single station power supply, Rack dimensions and weights (without modules) shall not exceed:
    - a. DRd6      21.9" H x 17" W x 9.6" D      38 lb.
  4. A single low-noise fan shall be located at the top of each rack. The fan shall draw all intake air through the integral electrostatic air filter, over the surfaces of the module housing and out the top of the rack.
    - a. The fan shall maintain the temperature of all components at proper operating levels with dimmers under full load, provided the ambient temperature of the dimmer room does not exceed 40°C/104°F.
    - b. In the event of an over-temperature condition, only the affected dimmer module(s) shall shut down. A red indicator LED will flash and an error message shall appear on the Control Processor.
  5. Rack Enclosures shall be designed to allow easy insertion and removal of dimmer and control modules without the use of tools. (230 volt racks with CE certification shall require a screwdriver.)
    - a. Supports shall be provided for precise alignment of modules into power and signal connector blocks.
    - b. With modules removed, racks shall provide clear front access to all load, neutral and control wire terminations.
  6. Rack Enclosures shall support use of any combination of rack option cards designed to provide additional rack features. Rack option cards shall include:
    - a. FLO - The Fluorescent Option Board shall provide termination for 4 wire low voltage electronic fluorescent dimming ballasts. FLO shall provide 24, 0-10Vdc outputs.
    - b. DALI - The DALI Option Board shall provide termination for DALI fluorescent dimming ballasts. DRd shall provide 24, DALI outputs for up to 63 ballasts each in a broadcast mode.
  7. Optional floor mounting pedestal shall be available for the 12-module rack.
  8. Racks enclosures shall be designed for use with AX series auxiliary racks for Main

Circuit Breaker, Main Lug, and cross bussing applications.

C. Electrical

1. Rack enclosures shall be available in 100, 120, 230, 240 and 277 volt, three-phase, main lug configurations.
  - a. 120 volt rack enclosures shall be field configurable for single phase operation without the need for additional components
2. Rack enclosures shall be completely pre-wired by the manufacturer. The contractor shall provide input feed, load, and control wiring.
3. Standard Short Circuit Current Ratings (SCCR) shall be 22,000 at 100-277 Volt
  - a. Higher SCCR ratings, up to 100,000 amps SCCR at 120V, shall be possible when used with an AX series Auxiliary Rack Enclosure.
  - b. Higher SCCR ratings, up to 65,000 amps SCCR at 240V and 277V, shall be possible when used with an AX series Auxiliary Rack Enclosure.
4. All control wire connections shall be terminated via factory provided connectors.
5. Rack enclosures shall support dimming for incandescent, fluorescent, neon, cold cathode, electronic low voltage and magnetic low voltage transformer load types.
  - a. The rack enclosure shall support 16-bit DMX input
  - b. The rack enclosure shall support 65,000 steps of dimming.
  - c. The rack enclosure dimming engine shall support multiple dimmer curves including modified square law, linear, switched, fluorescent, pre-heat and electronic low voltage.
  - d. The rack enclosure shall support voltage regulation including, minimum and maximum scale voltages with offsets
  - e. Rack enclosure shall support a UL924 listed contact input for emergency lighting control bypass.
  - f. Emergency lighting input shall support load shedding
  - g. Rack enclosures shall be designed to support the following wire terminations:
  - h. AC
  - i. Echelon link power (Belden 8471 or equivalent)
  - j. 24Vdc (2- 16AWG Wire)
  - k. DMX512A Port A (In or Out) (Belden 9729 or equivalent)

- l. DMX512A Port B (Out) (Belden 9729 or equivalent)
- m. RS232 Serial In/Out (Belden 9729 or equivalent)
- n. Unshielded Twisted Pair (UTP) Category 5/5e Ethernet
- o. Contact Closure In (14AWG to 26AWG Wire)
- p. Contact Closure Out (14AWG to 26AWG Wire)
- q. Contact Closure Out shall provide 1A @ 30vDC

**D. Thermal**

- 1. Ambient room temperature: 0-40°C / 32-104°F
- 2. Ambient humidity: 10-90% non-condensing

**2.6 RELAY MODULES**

**A. Mechanical**

- 1. ETC relay modules shall be designed for use with Unison or Sensor dimming racks.
- 2. Dimmer modules shall consist of a heavy-duty, die-cast aluminum chassis with an integral faceplate. All parts shall be properly treated, primed and finished in fine-texture, scratch-resistant gray epoxy powder coat.
- 3. Modules constructed of molded plastic for structural support are not equivalent and are not acceptable.
- 4. With the exception of the circuit breaker, the module shall contain no moving parts.
- 5. Each module shall be labeled with the manufacturer's name, catalog number and rating.
- 6. All electronic components (current/voltage sensors and indicators) shall be contained in a single field-replaceable housing.

**B. Electrical**

- 1. Each dimmer shall consist of the following components:
  - a. One or two single-pole circuit breakers
  - b. Circuit breakers shall be fully magnetic so the trip current is not affected by ambient temperature.
  - c. Circuit breakers shall be rated for tungsten loads having an inrush rating of no less than 20 times normal current.
  - d. Circuit breakers shall be rated for 100 percent switching duty applications.



2. Power and control connectors.
  - a. Modules shall not have any protruding pins subject to physical damage when the module is not installed.
  - b. Power efficiency for standard dimmers shall be at least 97 percent at full load with a no-load loss of 3V RMS.
  - c. The relay shall accept hot patching of a cold incandescent load up to the full rated capacity of the dimmer.
  - d. Relay modules shall be UL and cUL(120V, 240V and 277V listed) or CE marked (230V) power control devices with Standard SCCR fault current protection shall be 100,000 Amps at 120V and 24,000 Amps at 230V, 240V and 277V.

## 2.7 ARCHITECTURAL CONTROL PROCESSOR MODULE

### A. Mechanical

1. The Architectural Control Processor (ACP) assembly shall be designed for use in DRd Series Power Enclosures and ERn Series Control Enclosures.
2. The processor shall utilize microprocessor based, solid state technology to provide multi-scene lighting and building control.
3. ACP module electronics shall be contained in a plug-in assembly.
  - a. The module shall be housed in a formed steel body and contain no discrete wire connections.
  - b. No tools shall be required for module removal or insertion.
4. CONTROL PROCESSOR MODULES
5. The Architectural Control Processor shall be the Unison Paradigm Series, P-ACP Control Processor as manufactured by Electronic Theatre Controls, Inc., or equal.
6. The ACP shall be convection cooled.
7. User Interface
  - a. The ACP shall utilize a backlit liquid crystal display capable of graphics and eight lines of text.
  - b. The ACP shall provide an alpha-numeric keypad for data entry and navigation.
  - c. The ACP shall provide a touch-sensitive control wheel for navigation.
  - d. The ACP shall provide shortcut buttons to assist in navigation, selection, and data entry.
  - e. The ACP keypad, buttons, and wheel shall be backlit for use in low-light conditions.

- f. The ACP shall provide a front-panel RJ45 receptacle for Ethernet connection to the processor for configuration, live control, and web-browser-based system access.
  - 1) The RJ-45 receptacle shall be secured behind the locking door.
8. The ACP shall provide a Secure Digital (SD) Removable Media slot on the front panel for transfer of configuration data
  - a. The SD slot shall be secured behind the locking door.
  - b. The ACP shall provide a Universal Serial Bus (USB) port on the front panel for transfer of configuration data.
  - c. The USB port shall be secured behind the locking door.
9. Functional
10. Capacity
  - a. Shall support 1024 channels of control
  - b. Shall support 2 physical DMX ports, each of which may be configured as an input or output
11. System
  - a. Runtime application shall utilize support Net3 system interoperability
  - b. System shall support the use of Network Time Protocol for real time clock synchronization
  - c. System shall support remote firmware upload an over Ethernet connection from a connected PC running the Light Designer software or another connected processor.
  - d. System shall support local firmware upload from removable media (SD Card, USB Flash Drive)
    - Diagnostics
  - e. Shall output an Event log
  - f. Standard log shall store a fixed-length history of recent activity
  - g. Separate critical log shall only store important messages (such as boot-up settings)
12. Architectural Lighting System configuration and program information shall be stored in flash memory, which does not require battery backup.
13. The ACP shall provide a Compact Flash (CF) Card as backup flash memory and storage.
14. The CF Card is located in the back of the ACP, and can be accessed only by removing the ACP.

15. The ACP data can be exchanged by inserting the CF card into another ACP.

B. Electrical

1. The ACP shall require no discrete wiring connections; all wiring shall be terminated into Dimming or Control Enclosure.
2. The ACP shall require low-voltage power supplied by the Dimming or Control enclosure.
3. The ACP shall be hot-swap capable.
4. The ACP shall support Echelon LonTalk with LinkPower communications with control stations and other remote devices, including button stations, button/fader stations, Touchscreen stations, sensors, and third party LonMARK compliant products.
  - a. The LinkPower network shall utilize polarity-independent, low-voltage Class II twisted pair wiring, type Belden 8471 (unshielded) or Belden 8719 (shielded) or equivalent. One # 14 AWG drain wire will be required for system not using grounded metal conduit. Touchscreen stations, interface stations and portable stations connectors will also require (2) #16 AWG wires.
  - b. The LinkPower network shall be topology free. Network wiring may be bus, loop, home run, star or any combination of these.
  - c. Link power wiring shall permit a total wire run of 1640 ft. (500m) without a repeater. Repeater option modules shall be available to increase wiring maximums in increments of 1640 ft. (500m).
  - d. Link power wiring between stations shall not exceed 1313 ft. (400m).
5. The ACP shall support 10/100BaseTX, auto MDI/MDIX, 802.3af compliant Ethernet networking using TCP/IP, ESTA BSR E1.17 Advanced Control Networks (ACN) and ESTA BSR E1.31 (sACN) Protocols for internal communication and integration with third-party equipment.
6. The ACP shall support EIA-RS232 serial protocol for bi-directional command and communication with third-party equipment.
7. The ACP shall support two discrete ESTA DMX512A ports, configurable as input or output ports. \*
  - a. \*When used in a Dimming Enclosure, the second port is always an output port.
8. The ACP shall provide four onboard dry contact closure inputs for integration with third-party products.
9. The ACP shall provide four onboard contact closure outputs, rated at 1A@30VDC, for integration with third-party equipment.
10. Access Controls

11. Configuration Data
  12. Configuration Data can be uploaded over an Ethernet connection from a PC running Light Designer application
  13. Configuration Data can be retrieved from another Paradigm Processor
  14. A Paradigm Processor shall make its configuration data available for retrieval by another Processor as a backup/recovery mechanism
  15. Configuration Data shall be stored on solid-state media that can be removed to facilitate transfer between Processor units
  16. Configuration Data may be loaded to and from removable media access provided on front panel
  17. Configuration Data for the entire System shall be available for download from any single Processor
  18. Shall store configuration data for Dimming enclosure processors and shall make available for download
  19. Scalability
  20. Adding additional Processors to a System shall proportionately increase its overall capabilities up to a maximum project size
  21. The maximum number of Processors configured as a project shall be at least 12. The use of a Central Control Processor (P-CCS) shall allow for larger system sizes up to 72 processors
  22. Multiple Processors shall utilize the Ethernet network to remain time synchronized and share control information
  23. Multiple Processors shall utilize the Ethernet network to maintain configuration data synchronization as modifications are made
  24. Failure of a single Processor shall not prohibit continuing operation of the remaining Processors
  25. It shall be possible for multiple Systems to coexist on the same physical network with logical isolation between Systems
- C. Stations
1. Stations shall be connected to a Paradigm Processor via a LinkPower network or Ethernet
  2. Station discovery and binding shall be accomplished from the Local User Interface or Light Designe
- D. ACN Devices

1. Paradigm Processors shall provide DMX-Net3 gateway functionality
2. Net3 devices shall be connected to and controlled from the Processor via Ethernet
3. It shall be possible to send and receive Macro triggers defined within the System configuration via Net3
4. There shall be support for a maximum of 1024 Streaming ACN outputs configured to a maximum of 12 universes per Processor Operation

## 2.8 THEATRE BUTTON STATIONS

A. The Lighting Control Stations shall be the Unison Heritage UH Series Control Stations as manufactured by Electronic Theatre Controls, Inc., or equal.

### B. MECHANICAL

1. Unison Heritage Button and Button/Fader Stations shall operate using up to sixteen programmable faders and twelve programmable buttons.
2. All button/fader stations shall be available with white, cream, ivory, gray or black faceplates, fader knobs, and buttons.
  - a. Manufacturer's standard colors shall conform to the RAL CLASSIC Standard.
3. Stations shall have indicators lights at each button or fader.
  - a. Indicators shall be comprised of red, green and blue LED's
  - b. Indicator color and state (steady On, Blink, Off) shall be configured in software, and shall operate relative to the button or fader it is associated with.
4. All faceplates shall be designed for flush or surface mounting.
5. Station faceplates shall be constructed of ABS plastic and shall use no visible means of attachment.
6. Station faceplates shall be indelibly marked for each button or fader function.
7. The manufacturer shall supply back boxes for flush mounted half gang stations and for all surface mounted stations.

### C. Functional

1. The Unison Paradigm Control System shall be designed to allow control of lighting and associated systems via Button, Button/Fader, and Interface or Astronomical time clock controls. System shall allow the programming of presets, sequences, macros and time clock events.
2. Station Button, Button/Fader, and Interface) control components shall be designed to operate standard default or custom system functions. Components shall operate default functions unless re-assigned via LightDesigner, the Windows-based configuration

program.

3. Stations (Button and Button/Fader) shall allow programming of station and component electronic lockout levels via LightDesigner.

D. Electrical

1. Unison control station wiring shall be an Echelon® Link power network.
  - a. Link power shall utilize low-voltage Class II unshielded twisted pair, type Belden 8471 or equivalent, and one #14 ESD drain wire (when not installed in grounded metal conduit).
  - b. Touchscreen and Interface stations shall also require (2) #16 AWG stranded wires for 24Vdc operating power. 24Vdc wiring shall be topology free.
  - c. Network wiring may be bus, loop, home run, star or any combination of these.
  - d. Network insulation displacement connectors shall be provided with all stations.

2.9 TOUCHSCREEN CONTROL STATIONS

- a. The Touchscreen Control Stations shall be the Unison Paradigm Touchscreen P-TS7 Series Control Stations as manufactured by ETC, Inc., or equal.

B. General

1. Touchscreen stations shall support default and fully graphical control pages.
2. The Touchscreen station shall operate using graphic buttons, faders and other images on at least 30 separate programmable control pages.
3. Touchscreen stations shall also allow programming of page pass-code, lock out and visibility levels.
4. Mechanical
5. Touchscreen stations shall consist of a seven-inch, backlit liquid crystal display (LCD) with a minimum resolution of 800 by 400 pixels and 24-bit color depth with a capacitive touch interface.
6. Touchscreen bezels shall be constructed of cast aluminum finished in a fine texture powder coat.
7. Touchscreen shall be available in five standard colors
  - a. Black (RAL 9004)

C. The bezel shall have no visible means of attachment.

D. The bezel shall allow the touchscreen to be installed and removed without the use of tools.

- E. The bezel shall provide two working positions for the Touchscreen: service and normal operation.
1. Touchscreen shall offer optional hinged locking covers
    - a. Locking covers shall be made from cast aluminum and be painted to match standard touchscreen color options
    - b. Locking covers shall allow for viewing of system status on the touchscreen through a smoked Lexan window
  2. The manufacturer shall provide back boxes for all LCD stations.
    - a. Flush back box for Touchscreens with or without locking covers shall be 202mm wide x 135.4mm high x 83mm deep
    - b. Surface back box dimensions shall be 211mm wide x 142mm high x 70mm deep
    - c. Surface back box for Touchscreens with locking cover dimensions shall be 254mm wide x 170mm high x 70mm deep
  3. Electrical
    - a. Touchscreens shall be powered entirely by the System network.
    - b. Touchscreens shall connect to the System using an Ethernet network with Power over Ethernet (PoE) or the Unison control station Echelon® Link power network.
      - 1) Ethernet Network
        - a) Ethernet network shall be 10/100BaseTX, auto MDI/MDIX, 802.3af (PoE) compliant.
        - b) Network shall utilize Unshielded Twisted Pair (UTP) Category 5, or better wiring.
        - c) PoE power consumption shall be PoE class 2, consuming no more than 6 watts.
      - 2) Echelon® Link power network.
        - a) Link power shall utilize low-voltage Class II unshielded twisted pair, type Belden 8471 or equivalent, and one 2.5mm<sup>2</sup> ESD drain wire (when not installed in grounded metal conduit).
        - b) Touchscreen stations shall also require (2) 1.5mm<sup>2</sup> stranded wires for 24VDC operating power. 24VDC wiring shall be topology free.
        - c) Network wiring may be bus, loop, home run, star or any combination of these.

- d) Network insulation displacement connectors shall be provided with all stations.

#### 4. Functional

##### a. System

- 1) The Touchscreen shall support configuration firmware upload from a Paradigm Processor as proxy
- 2) The Touchscreen shall support configuration or firmware upload from local removable media

##### b. Configurations

- 1) It shall be possible to have multiple configurations stored within an LCD Station
- 2) Where multiple configurations are stored there shall be a boot menu to allow selection of a configuration

##### c. Operation

- 1) The Unison Paradigm Control System shall be designed to allow control of lighting and associated systems via Touchscreen controls. System shall allow the control of presets, sequences, macros and time clock events.
- 2) System presets shall be programmable via Button, Button/Fader, Touchscreen, or LightDesigner software.
  - a) Presets shall have a discrete fade time, programmable from zero to 84,600 seconds with a resolution of one hundred milliseconds.
  - b) Presets shall be selectable via Touchscreen stations.
  - c) System macros and sequences shall be programmable via LightDesigner system software.
  - d) Macro and sequence steps shall provide user selectable steps, and allow the application of conditional logic.
  - e) Macro and sequences shall be activated by button, time clock event or LightDesigner software.
- 3) Optional button functions include: preset selection, manual mode activation, record mode activation, station lockout, raise, lower, macro activation, and cue light, or room join/separate.
- 4) Optional fader functions include master control, individual channel control, fade rate control or preset master control.

#### 2.10 EMERGENCY BYPASS DETECTION KIT (EBDK)



- A. Where required to detect the loss of normal power and trigger special-purpose lighting presets, the detection means shall be the Emergency Bypass Detection Kit as manufactured by Electronic Theatre Controls, Inc., or equal.
- B. Mechanical
1. The Kit Enclosure shall be a surface mounted, constructed of 16-gauge, formed steel panels with a removable front cover.
  2. The Emergency Bypass Detection Kit shall include a 3-pole, 10 amp breaker for local over-current protection and simulation of normal power loss.
  3. The enclosure shall have a lockable door to allow limited access to the over-current protection breaker
  4. All components shall be properly treated and finished.
  5. Exterior surfaces shall be finished in fine textured, scratch-resistant, powder coat paint
  6. The EBDK enclosure shall provide discrete high and low voltage wiring compartments with voltage barrier.
- C. Electrical
1. Emergency Bypass Detection enclosures shall support 100 to 277 volt configurations
    - a. EBDK enclosures shall be field configurable for single-phase, bi-phase, and three-phase operation without the need for additional components.
  2. Phase Loss Detection circuitry shall provide 0.5 second delay to prevent nuisance tripping
  3. The EBDK shall provide an integrated circuit breaker for over-current protection and simulation of normal power loss
  4. The Emergency bypass detection Kit shall support isolated outputs for connection to multiple dimming products simultaneously
    - a. Three isolated contacts shall be provided
    - b. Each contact shall support connection of up to four dimming products.
  5. The Emergency Bypass Detection Kit shall be completely pre-wired by the manufacturer. The contractor shall provide input feed and control wiring.
  6. All control wire connections shall be terminated via factory provided connectors.
    - a. Factory provided connector shall support 12 to 22-gauge wiring
    - b. Emergency lighting input shall support load shedding
  7. The Bypass Detection Kit shall provide a normally-closed input for interface with fire

alarm systems

8. The Bypass Detection Kit shall be UL and cUL Section 924 Listed for interaction with similarly listed dimming and switching panels

D. Thermal

1. Ambient room temperature: 0-40°C / 32-104°F
2. Ambient humidity: 10-90% non-condensing

2.11 DMX EMERGENCY BYPASS CONTROL

A. Where required to trigger special-purpose lighting presets and bypass normal lighting controls during emergency or panic situations, the bypass means shall be the DMX Emergency Bypass Controller (DEBC) as manufactured by ETC, Inc., or equal

B. Functional

1. The DMX Emergency Bypass Controller shall be capable of overriding a single universe of ANSI E1.11–2008, USITT DMX512-A control signals from “Normal” to “Bypass” when a trigger signal is detected via a contact closure trigger input
  - a. The DMX Emergency Bypass Controller shall output to a single DMX output or up to six optically-isolated DMX outputs
  - b. The DMX Emergency Bypass Controller shall poll the bypass trigger input after a power loss and react upon start up
  - c. The default or recorded preset shall be recalled immediately on restart if the trigger is also applied at restart
  - d. Controllers that do not support E1.11–2008 compliant DMX communication shall not be acceptable

2.12 EQUIPMENT RACK

A. Equipment Rack, EIA compliant 19” wall mount rack shall be Middle Atlantic Products model # DWR-18-32. or equal.

B. GENERAL

1. Useable depth shall be 30” and shall extend into the back pan 3.5”. Center section and back pan shall be 16-gauge steel, phosphate pre-treated and finished in a black textured powder coat.
2. Rackrail shall be constructed of 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing with black e-coat finish and marked rackspaces
3. Rack shall have a rear knockout panel with 1/2”, 3/4”, 1”, 1-1/2”, 2” and 3” electrical knockouts installed in base, and a rear knockout panel with 1/2”, 3/4”, 1”, 1-1/2”, 2” and

3" electrical knockouts, four Decora® cutouts, and BNC knockouts for UHF/VHF antennas installed in top

4. Rack shall have 2" knockouts, 4" knockouts for Wiremold 4000® Series raceways, and knockouts for UCP Series universal connector panels on the side
5. Rack shall be UL Listed in the US and Canada. Rack shall be GREENGUARD Indoor Air Quality Certified for Children and Schools. Rack shall comply with the requirements RoHS EU Directive 2002 / 95 / EC
6. Rack shall be manufactured by an ISO 9001 and ISO 14001 registered company. Rack shall be warranted to be free from defects in materials or workmanship under normal use and conditions for the lifetime of the rack.

### 2.13 NETWORK SWITCH

- A. Network Switch shall be a Cisco Switch 24 Port POE unmanaged SG110 - 24GP - 1U or equal.
- B. GENERAL
  1. Standard: IEEE 802.3 10BASE-T Ethernet, IEEE 802.3u 100BASE-TX Fast Ethernet, IEEE 802.3ab 1000BASE-T Gigabit Ethernet, IEEE 802.3z Gigabit Ethernet, IEEE 802.3x Flow Control, 802.1p priority, Energy Efficient Ethernet, 802.3af, Power over Ethernet
  2. Cabling type shall Category 5e or greater.
  3. LED indicator are System/PWR, link/activity, 100M,\*PoE, \*Max PoE, cable diagnostics, loop detection, gigabit,\* mini-GBIC\* if present.
- C. PHYSICAL INTERFACE
- D. 10/100/1000 Ethernet, with support for 802.3af PoE, power port for AC adapter or power cord
- E. Dimensions 17.32 x 7.97 x 1.73 inches (440 x 203 x 44 mm)

### 2.14 DMX/RDM ETHERNET GATEWAY

- A. GENERAL
  1. The lighting control gateway shall be a microprocessor-based unit specifically designed to provide DMX-512 control of lighting systems and transport of RDM configuration and status messages. The gateway shall permit DMX-512 data to be encoded, routed over an Ethernet network and decoded back to DMX-512. The unit shall be a Portable DMX/RDM 1-port Gateway as provided by ETC, Inc.
  2. Gateways shall communicate over Ethernet directly with lighting control products and other Ethernet interfaces.

3. The gateway shall support multiple protocols including:
  - a. ANSI E1.17 Architecture for Control Networks (ACN)
  - b. ANSI E1.31 Streaming ACN (sACN)
  - c. ANSI E1.11 USITT DMX512-A
  - d. ANSI E1.20 Remote Device Management (RDM)
4. The gateway shall be tested to UL standards and labeled ETL Listed.
5. The gateway shall be RoHS Compliant (lead-free).
6. The gateway shall be CE compliant.
7. The gateway shall have a backlit graphic LCD display for identification (soft-labeling) and status reporting.
  - a. Labeling shall be user configurable using ANSI E1.17 Architecture for Control Network (ACN), or a purpose-built software configuration tool.
  - b. The LCD display shall show DMX port configuration indication as well as indicate the presence of valid signal.
8. Each gateway shall have power and network activity LEDs on the front of the gateway

**2.15 EQUIPMENT RACK, UNINTERRUPTIBLE POWER SUPPLY**

- A. Premium Rackmount Uninterruptible Power Supply (UPS) shall be Middle Atlantic Products model # UPS-1000R.
- B. GENERAL
  - a. UPS shall be line interactive with AVR.
- C. PHYSICAL
  1. 19.00" W x 3.50" H x 19.00" D and occupy 2 rackspaces.
  2. UPS shall have a rear mounting range of 19" to 32"
- D. ELECTRICAL
  1. unit shall operate on 120 VAC/60Hz current.
  2. Unit shall have a nominal output of 120V.
  3. Unit shall have a capacity of 1000 VA and 750 W
  4. Unit shall have (8) NEMA 5-15R receptacles on the rear of the unit. Unit shall have a priority outlet bank consisting of 4 outlets dedicated to ensure maximum run time of

critical components. Unit shall have a non-critical outlet bank consisting of 4 outlets

5. UPS shall have surge suppression that utilizes a clean line-to-neutral design that does not pass noise contamination to ground.

**E. WARRENTY**

1. Rackmount UPS shall be warrantied to be free from defects in materials and workmanship under normal use and conditions for a period of 3 years; battery shall be warrantied for a period of 2 years. Rackmount UPS shall be UL listed in US and Canada.

**2.16 RIGGING HOISTS WITH COMPRESSION TUBE**

**A. General**

1. Hoists shall be purpose-designed and fabricated for overhead lifting of theatre lights, equipment, curtains and scenic elements, whether used on stage, in the auditorium or other places of public assembly where people shall move beneath the suspended or moving load. The systems shall incorporate mechanical, electrical and safety features that shall be inherent to this equipment; they shall provide an engineered, efficient device for overhead lifting. The mechanical, electrical and safety features of this hoisting and control system shall establish the standard of quality, performance and safety by which hoisting systems of other manufacture shall be evaluated.
2. Each hoist shall be fully tested under full rated load throughout its full travel distance with all its lift lines terminated to the hoist before the hoist is shipped from the manufacturer. Only hoists that successfully pass the following pre-shipment testing shall be sent to any job site. Hoists that are not tested as a complete system with the wire rope and loft blocks that will install with the hoist in the field shall not be acceptable. Testing shall include:
  - a. Hoist operation
  - b. Hoist/motor speed
  - c. Lift line terminations under load
  - d. Braking and stopping under load
  - e. Load cell functions
  - f. Slack line detection
  - g. Position sensing
  - h. Hoist noise
3. A record of testing and its results shall be available for review at the manufacturer's facility.
4. A copy of all testing results must be furnished by the installing contractor to the architect

or owner representative at the time of system commissioning. Manufacturers who cannot provide testing results shall not be acceptable.

5. Paint as required under this section shall be the manufacturer's standard finish and color except as noted.
6. All equipment items shall be new and conform to applicable provisions of Underwriters' Laboratories (UL), American Standards Association (ASA), American National Standards Institute (ANSI), National Fire Protection Association (NFPA) Life Safety Code 01, National Electric Code (NEC) and PLASA.
  - a. Where acceptable equipment items are specified by catalog number only, device shall meet all published manufacturer's specifications. Where quantities or sizes are not given, refer to drawings. Where two or more products are listed, contractor may use either, at his discretion. Equipment shall not be substituted without specific written approval by the Architect under the substitution paragraphs of these specifications.
  - b. All pipe battens shall be fabricated from 1.5" Schedule 40 pipe.
  - c. All turnbuckles and cable clips shall be drop forged.
  - d. All turnbuckles and clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized. Fasteners, chain, and other miscellaneous hardware shall be either cadmium or zinc plated.
  - e. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
  - f. In order to establish minimum standards of safety, a minimum factor of 10 shall be required for all equipment and hardware used on this project. In addition, the following factors shall be used:
    - g. 10 Design Factor
    - h. 26 times diameter
    - i. 2 degrees
    - j. 1/5 of yield
    - k. Two times required load at full for 2000 hours

**B. HOISTS**

1. Each wire rope lift line shall adhere to a design factor of 10:1 with an ultimate strength of 4200 pounds. All load path components between the building structure and the batten shall exceed the breaking strength of the wire rope. The motor brake shall be rated at least at 125% of the motor torque.
2. Hoists shall be capable of supporting the following loads:

- a. Stage Electric 30 fpm 1500 pound capacity in standard configuration. Powerhead shall measure 16" high x 18" w x 53 1/2" long and weigh 580 pounds
3. The standard general-purpose hoist shall consist of the following major components: 1) Powerhead, 2) compression tube with beam clamps, loft blocks, lift line and lift line terminations, Right Angle Cable Adjuster (RACA) and 3) pipe batten.
4. The standard stage electric hoist shall consist of the following major components: 1) Powerhead, 2) Compression Tube with beam clamps, cable management system, loft blocks, lift line and lift line terminations Right Angle Cable Adjuster (RACA), 3) pipe batten and power/control distribution strip
5. The hoist shall include the following features:
  - a. A Powerhead containing the following elements: the gear motor, motor brake, load brake, limit switches operating electronics, load cell, slack line detector, absolute position sensors, cable drum assembly, and wire rope.
  - b. A Compression Tube that prevents hoist system lateral forces from transferring to the building. Hoists or hoisting systems that impose a lateral load on the building shall not be acceptable.
  - c. The hoist shall incorporate a built-in load cell.
  - d. The hoist shall incorporate a built-in slack line sensor.
  - e. The hoist shall include the emergency contactor built into the hoist
  - f. Hoists that do not include built-in load cell, built-in slack line detection, and an emergency contactor shall not be acceptable.
  - g. Hoists that do not use absolute position encoders shall not be acceptable.
6. The hoist shall be manufactured from UL Listed components and shall be UL Listed and tested as a complete system (not just UL listed parts).

#### C. POWERHEAD

1. The Powerhead shall be a fully enclosed, powder coated sheet metal housing that shall prevent contact with moving and electrical parts and shall provide protection against dirt, dust and debris.
2. Hoist assemblies that do not have metal housings prohibiting access to moving parts shall not be acceptable.
3. For setup and maintenance, the following functions shall be available from the Powerhead: power and operating switches, address setting knobs, limit switch setting knobs, limit switch override button, indicators for power, status and communication. Each of these functions shall be clearly labeled.

#### D. GEARMOTOR AND MOTOR BRAKE

1. The gear motor and motor brake shall be an integral unit from a single manufacturer. It shall operate on 208 Volt or 480 Volt 60 Hz, 3 phase current for fixed speed units and 480 Volt, 60 Hz, 3 phase current for variable speed hoists.
2. The motor brake shall be integral to the gear motor and shall be capable of holding 125% of the motor full load torque.
3. The motor brake shall be spring actuated to apply and hold braking force.
4. The motor brake shall be magnetically released and held open upon actuation.

#### E. LOAD BRAKE

1. Fixed Speed Hoists
  - a. The rotary disk load brake shall bring the moving load to a complete stop and shall hold the load in position in the event of a mechanical failure of the motor, motor brake or gearbox.
  - b. Noise from the load brake shall be minimally audible at any time in the operational cycle.
  - c. Normal hoist operation shall not be limited by heat or noise caused by the load brake.
  - d. The load brake shall be mechanically released when the load is moving in the up direction. The load brake shall close when the hoist has stopped. The load brake shall always be engaged when the load has stopped moving either up or down. When lowering the load the load brake shall partially disengage to allow and control descent of the batten. The load brake shall remain closed in the absence of rotational torque on the gearbox.

#### F. WIRE ROPE DRUM

1. The drum shall be capable of wrapping up to eight 3/16" diameter 7 x 19 galvanized aircraft (utility) wire rope lift lines up to 50' long in a compact manner. They shall be managed by a wire rope (cable) keeper integral to the Powerhead. The drum design shall prevent wire rope from tangling or crossing over itself.

#### G. LIMIT SWITCH

1. A limit switch assembly shall be mounted within the Powerhead for hard "normal" and "ultimate" end of travel limits. Hard end of travel limits shall be set/adjusted at the time of installation aided by an indicator light visible on the bottom panel of the Powerhead cover. Any system that indicates that the limit has been set by audible or tactile means only shall not be acceptable.

#### H. LOCAL USER INTERFACE TO POWERHEAD

1. User interface at the Powerhead control panel at the rear of the hoist shall include:
  - a. Hoist Up/Down Control



- b. Limit Switch override buttons (tool accessible)
- c. Address switches
- d. Status LED' s

#### I. INFORMATION STORAGE WITHIN POWERHEAD

1. Record of severe fault conditions with date and time stamp
2. Record of E-stops, overloads, moves and power cycles
3. Record of travel distance and peak loads since installation/inspection
4. Hoist systems that do not record the above data shall not be acceptable.

#### J. COMPRESSION TUBE AND BEAM CLAMPS

1. The Compression Tube shall be a continuous channel of extruded aluminum engineered in conjunction with the beam clamps to neutralize rigging-generated lateral forces on the building.
2. The Compression Tube shall support the system loft blocks.
3. Compression Tube sections shall be joined into a continuous assembly by a pair of dedicated splicing plates at each tube joint.
4. The Compression Tube shall be installed only by means of dedicated beam clamps that allow the Compression Tube to snap into place and to fractionally move horizontally under load.
5. Beam clamps shall be capable of attaching to horizontal beams, joists, truss flanges or flat steel plates measuring from 1/4" thick up to 1" thick and from 4" wide up to 14" wide placed no more than 14' -0" apart. P650E, P800G, P1000E and P1300G Powerheads may be mounted on 1/4" thick x 4" wide or larger steel structures if deemed sufficient by a structural engineer. P1500E, P1900G and V1000S hoists must be mounted on 3/8" x 6" wide or larger steel if deemed sufficient by a structural engineer. Support structures must be deemed sufficient by a structural engineer to support any forces imposed by the hoisting systems. Beam clamps shall accommodate up to 1/2" vertical misalignment.
6. Hoist systems that do not neutralize hoist generated lateral forces on the building shall not be accepted for this project.

#### K. LOFT BLOCKS

1. Each loft block shall be an assembly of steel side plates, a wire rope idler, sheave, bearings, shaft locked against rotation and support hardware. Each loft block shall be inserted into the slot on the bottom of the Compression Tube. The blocks shall be positioned no closer than 4' -0" from each other, unless muled.
2. Loft block sheaves shall measure 5" in diameter and contain a pair of press fit sealed ball

bearings. Lift lines shall travel in a groove shaped and sized for 3/16" diameter wire rope per the latest edition of the Wire Rope Users' Manual as published by the Wire Rope Technical Board. The loft block sheave shall be concentric about the hub and shall be evenly balanced for ease of rotation.

3. An idler shall be incorporated into the top assembly of the loft block to guide and support lift lines as they pass the block.
4. Hoisting systems requiring the loft blocks to be mounted directly to the facility structure shall not be accepted for this project.

#### L. LIFT LINE TERMINATIONS

1. Each lift line shall be terminated in the Powerhead via a standard copper oval compression sleeve installed/crimped at the factory.
2. Lift lines shall be terminated at the load hanger with a low-profile Right-Angle Cable Adjuster (RACA)™, thimble and copper oval compression sleeve. The RACA and cable terminations at the batten shall be installed at the time of hoist installation.
3. Batten trim shall be adjustable up to 6" via the RACA.
4. Systems utilizing turnbuckles or chain to trim the batten shall not be accepted for this installation.

#### M. HANGERS

1. Raceway hangers shall be specially shaped flat bar that shall support the wire rope termination hardware and secure the raceway and the pipe batten.

#### N. PIPE BATTEN

1. The pipe batten shall be 1½" schedule 40 grade A, seamless pipe fabricated in the largest possible lengths without splices. Battens of greater length shall be spliced by means of .120 x 1 9/16 dia. DOM tube 18" long with 9" of tube inserted into each half of the splice. The tight-fitting splice tube shall be held in place by a pair of 3/8 x 2 ½" grade 5 hex bolts on each side of the joint. The bolts shall pass through the pipe at an angle of 90° to each other. There shall be two bolts on each side of the joint spaced 1" and 8" from the joint. Alternatively, one pair of bolts on one side of the joint may be replaced with either plug welds or tight-fitting steel rivets. Pipes shall be straight and painted flat black.
2. A safety-yellow batten cap shall be installed at each end of each pipe batten.
3. The manufacturer shall provide up to four self-adhesive labels for each batten on which the rated batten load shall be written by the installer.

#### O. POWER AND CONTROL DISTRIBUTION (PCD)

1. Each hoist shall receive power and control via a pair of 8' -0" long cables extending from the Powerhead to the source outlets. Receptacles shall be installed in a sheet metal junction box or trough with outlets. Each outlet shall be located no more than 6' -0" away

from the rear face of each hoist.

2. Each Powerhead shall include a power cord hardwired to the hoist with an appropriately sized grounded twist-lock connector at the PCD end and a removable control cable with a circular 9 pin connector at each end. An appropriately rated 3 phase breaker in the PCD is included. The wiring and connectors shall be barriered between high and low voltage.
3. The power/distribution channel shall be UL LISTED for this application.

## 2.17 QUICKTOUCH FIXED SPEED CONTROL SYSTEM

### A. GENERAL

1. The entire motor system shall be operated by a QuickTouch fixed speed controller. It shall be purpose-designed and fabricated to manage and operate motors specifically designed for overhead lifting. Each system shall incorporate mechanical, electrical and safety features that shall be inherent to this equipment and shall provide an engineered, efficient device to control the equipment. The mechanical, electrical and safety features of this control system shall establish the standard of quality, performance and safety by which motoring systems of other manufacture shall be evaluated.
2. The QuickTouch Control System shall consist of a surface, flush or rack mounted primary control panel and up to three remote E-stop stations.
3. The motoring system shall also include one QuickTouch Fixed Speed Remote control device with 30' of flexible cable that may be attached to the system at the QuickTouch control panel.
4. The controller shall include the following features:
  5. Key operated power switch
  6. LCD display for feedback/operating information
  7. Key operated motor load profile training/enable switch
  8. Latching motor selection buttons with rear illuminated naming tabs
  9. Rear illuminated hold-to-operate (dead-man) up and down operation buttons
  10. Dedicated E-stop button
  11. Outlet for wired remote
  12. Optional door
  13. Optional rack mount kit
14. The control system shall only employ the QuickTouch controller, a power and control distribution infrastructure and the motors. A System that requires separate drive cabinets or motor-starters shall not be acceptable.

**B. ENCLOSURE**

1. The back box and face panel shall be fabricated from 16ga powder coated sheet steel specially formed to provide support for installation as well as support for all components installed within the housing.
2. The QuickTouch face panel shall be printed with complete labeling information to identify the function of each of the buttons in the control station.
3. The face panel shall identify the system as a QuickTouch controller for stage rigging.
4. The face panel shall be shades of grey. The ring surrounding the E-stop button shall be safety yellow and shall be rear illuminated
5. The steel panel to which all switches are mounted shall be removable via screws in the surface located underneath the face panel film.

**C. LCD SCREEN**

1. The liquid crystal display shall be purpose designed to communicate all information in human readable text.
2. The screen shall be rear illuminated and shall be dimmable.
3. During system start up the screen shall show the progress of the motors diagnostics self-tests. Upon completion of the startup sequence, the screen shall indicate that the system is "OK" or shall provide specific information should a fault be detected. Fault conditions shall be reported in human readable text. Systems that report fault conditions in a series of blinking lights shall not be acceptable for this installation.
4. When a motor is selected the LCD screen shall readout the motor name or number, its current position above the floor, the amount of weight suspended from the batten, the preset position that is recorded, as well as a bar graph scale that shows the current position of the motor, top and bottom limits and the current weight suspended from the motor.

**D. MOTOR SELECTION/OPERATION BUTTONS**

1. There shall be rear illuminated motor selection buttons. Buttons shall remain illuminated until de-selected.
2. Up to four motors may be selected to move at one time. When the up or down button is pushed and held, each motor shall move to its next stop location. If the stop location is the adjustable preset, the motor can be made to continue to travel in the selected direction by releasing and re-pressing the up or down hold-to-operate button until the next stop for the motor(s) is reached.
3. A maximum of four motors may move at one time and only in one direction at a time.
4. Although four motors moving at one time is the factory default, it shall be possible to increase to eight or reduce to one the quantity of simultaneously moving motors.

5. As a backup, there shall be dedicated hardware to detect and disable the system when the user attempts to move more than the configured maximum quantity of motors.
6. All buttons shall fit neatly within each of the cover panel cutouts on the controller.

**E. KEY SWITCHES**

1. A key switch shall control power to the control system. The key must be in the lock and the key turned to the on position for the motoring system to operate.
2. A separate key is required to turn on the load profiling system. That key must be in the lock and turned to the "ON" position for load profiling to function.
3. When load profiling is turned on the motor shall know the amount of weight that is supposed to be supported by the batten at any location in the path of travel. Should the weight exceed or be reduced below the profiled weight by a preset value, the motor shall stop operation until the fault is cleared.

**F. REMOTE CONTROL PENDANT**

1. An optional remote-control pendant with 30' long attached cable and plug shall be provided for the system. The remote control must be plugged to the QuickTouch control panel. When the remote control is plugged in the E-stop on the remote is active. Systems requiring "shunt plugs" to bypass an unplugged remote-control connector shall not be acceptable.
2. The remote control provides up/down control for those motors that have been preselected at the QuickTouch controller.

**2.18 POWER DISTRIBUTION – CONNECTOR STRIP**

**A. General**

1. Connectors shall be available as 20A twist lock.
2. Internal wiring shall be sized to circuit ampacity and shall be rated at 125°C
3. Pigtails shall be three-wire type "S" jacketed cable sized for the maximum circuit ampacity
4. Terminations shall be at one end using feed-through terminals individually labeled with corresponding circuit numbers
  - a. 20 amp circuits shall use screwless tension clamp terminals listed for 20 – 8 gauge wire
5. Connector strips shall be supplied with appropriate brackets and hardware for mounting as shown on the drawings
  - a. Connector strips shall have junction brackets on 5' centers

- b. Brackets shall be 1½” x .188” ASTM A36 steel
  - c. Hardware shall be ASTM A307 grade 5
6. A low voltage distribution system shall be available to incorporate DMX, Ethernet or other protocols as specified in the connector strip. Connector strips shall utilize a voltage barrier to accommodate these systems. Low Voltage signals shall enter the connector strip via a strain relief or connector mounted in a separate low voltage terminal box at the specified end of the connector strip. Up to four low voltage cables shall be supported for each connector strip
- a. Connector strips with multiple DMX outputs from the same source shall use DMX pass through assemblies consisting of a 6” panel with the one DMX output connector, one DMX input (Pass Through) connector, one DMX pass through (Bypass) switch, and a label detailing the use of the pass-through assembly
  - b. The bypass switch shall be used when no DMX devices are present at that location. When activated, the DMX pass through switch shall pass DMX directly through to the next DMX panel on the strip. The pass-through switch shall have a mechanical indicator to show the operator that it has or has not been engaged
7. Connector Strips shall be listed by a nationally recognized test lab (NRTL)

**B. Physical**

1. Connector strips shall be 6.25” H x 3.3” D and fabricated from 18-gauge galvanized steel and finished in black fine-texture powder coat paint
  - a. Covers shall be fabricated from 16-gauge galvanized steel
2. Connector strips shall be available in any length specified in increments of 6” and shipped fully wired with all splicing hardware
3. Pigtailed and outlets shall be spaced on 18” centers or as otherwise specified
4. Outlets shall be mounted on individual 3” panels
5. No external terminal boxes shall be required for connector strips with 28 or fewer circuits unless otherwise specified
6. Circuits shall be labeled on the connector strip with 2” lettering
  - a. Circuit labeling options shall include:
    - 1) Circuits shall be labeled on the front side of the connector strip with white lettering on black background labels
    - 2) Circuits shall be labeled on front and back sides of the connector strip with white lettering on black background labels
    - 3) Circuits shall be labeled on the front side of the connector strip with engraved

- lamacoid labels utilizing white lettering on black background labels
- 4) Circuits shall be labeled on the front and rear sides of the connector strip with engraved lamacoid labels utilizing white lettering on black background labels
  - 5) Circuits shall be labeled on one side of the connector strip using individual circuit cover plates with lettering engraved in the cover and filled with the specified color
  - 6) Circuits shall be labeled using specified labeling per plans and drawings
7. Connector strips shall support optional LED indicators to indicate the presence of power at each local circuit. The indicator shall be red in color and mounted in the connector strip
- a. The LED indicator shall be mounted in the lower right corner of the outlet panel
  - b. The LED indicator shall be mounted in the connector strip trough directly below the outlet panel
  - c. The LED indicator shall be mounted in the center of the 3” plate directly below the circuit label for pigtail circuits

**C. Junction Boxes**

- a. Gridiron junction boxes shall be available to accommodate “S” type cable wiring into connector strips mounted to non-fixed locations
- b. Junction Boxes shall be fabricated from 16-gauge cold rolled steel with 14-gauge end panels. They shall be finished with fine-textured, scratch-resistant, black powder coat paint. Cover(s) shall be 16-gauge cold rolled steel and hinged to allow mounting in any direction

**2.19 POWER DISTRIBUTION – WALL POCKET**

**A. General**

1. The wall pocket shall be a wiring device designed for flush mount installation into the wall.
2. Connectors shall be available as 20A grounded stage pin, 20A twist lock and 20A “U” ground (dual rated “T-slot”); other connectors shall be available as specified.
3. Terminations shall be made at each connector by the installer contractor.
  - a. 20-amp circuits shall use tension clamp terminals listed for 20 – 8-gauge wire.
  - b. Terminals that place a screw directly on the wire shall not be acceptable.
4. Wall pockets shall be supplied with back box and cover plate
5. The wall pocket back box shall have provisions for an integral voltage barrier for low

voltage circuits.

6. Wall pockets shall be listed by a nationally recognized test lab (nrtl).

**B. Physical**

1. Wall pocket back boxes shall be 8”H x 12”W x 6”D fabricated from 16-gauge cold rolled steel and finished in black fine-texture powder coat paint.
2. Wall pocket covers shall be constructed of .16-gauge cold rolled steel and finished in black fine-texture powder coat paint.
  - a. The cover shall be constructed with integral hinges and four (4) or six (6) cable notches dependent on circuit quantity.
  - b. Covers shall be attached to the back box using four (4) mounting holes and included hardware
3. Wall pocket connectors shall be mounted in a connector panel fabricated of 16-gauge steel finished in a low gloss black powder coat paint
  - a. The connector plate shall be attached to the Wall Pocket back box.
4. Circuits shall be labeled on the connector strip with 9/16” lettering.
  - a. Circuit labeling options shall include:
    - 1) Circuits shall be labeled on the front side of the connector panel with white lettering on black background labels.
    - 2) Circuits shall be labeled on the front side of the connector panel with engraved lamicoïd labels utilizing white lettering on black background labels.
    - 3) Circuits shall be labeled using specified labeling per plans and drawings

**2.20 DATA PLUG-IN STATIONS**

**A. GENERAL**

1. The Plug-in Stations shall consist of the appropriate connectors required for the functional intent of the system. These stations shall be available with Network, or architectural control connectors.

**B. CONNECTOR OPTIONS**

1. The following standard components shall be available for Plug-in Stations:
  - a. RJ45 connectors for Network connections - Twisted Pair
2. Custom combinations and custom control connections shall be available.

**C. PHYSICAL**



1. Station faceplates shall be .80" aluminum, finished in fine texture, scratch-resistant black powder coat. Silk-screened graphics shall be white.
2. The station panel shall mount into an industry standard back box, depending on size and quantity of connectors. A terminal block shall be supplied for contractor terminations.

**COLOR MIXING LIGHT EMITTING DIODE WASH FIXTURE**

**D. GENERAL**

1. The fixture shall be a color-mixing high-intensity LED illuminator with DMX control of intensity and color. The fixture shall be a ColorSource Par as manufactured by Electronic Theatre Controls, Inc. or approved equal.
2. All LED fixtures shall be provided by a single manufacturer to ensure compatibility
3. The fixture shall be UL 1573 listed for stage and studio use
4. The fixture shall comply with the USITT DMX-512 A standard

**E. PHYSICAL**

1. The fixture shall be contained in a rugged all-metal die-cast housing, free of burrs and pits
2. The housing shall have a rugged black powdercoat finish
  - a. White or silver/gray powdercoat finishes shall be available as color options
  - b. Other powdercoat color options shall be available on request
3. Power supply, cooling and electronics shall be integral to each unit.
4. Fixture housing shall provide two easy-access slots for secondary lenses and other accessories
  - a. Slots shall be equipped with locking retaining clip
5. The unit shall ship with
  - a. Theatrical-style hanging yoke as standard
  - b. 5' power lead with Edison connector as standard
6. Light output shall be via a round aperture

**F. ENVIRONMENTAL AND AGENCY COMPLIANCE**

1. The fixture shall be UL and cUL LISTED and/or CE rated, and shall be so labeled when delivered to the job site.
2. The fixture shall be UL LISTED to the UL1573 standard for stage and studio use

## G. THERMAL

1. The fixture shall be cooled with a variable speed fan.
2. The fixture shall utilize advanced thermal management systems to maintain LED life to an average of 70% intensity after 20,000 hours of use
  - a. Thermal management shall include multiple temperature sensors within the housing to include:
    - 1) The LED array
    - 2) The control board
3. The fixture shall operate in an ambient temperature range of 0°C (32°F) minimum, to 40°C (104°F) maximum ambient temperature.

## H. ELECTRICAL

1. The fixture shall be equipped with 100V to 240V 50/60 Hz internal power supply
2. The fixture shall support power in and thru operation
  - a. Power in shall be via Neutrik® PowerCon™ input connector
  - b. Power thru shall be via Neutrik ® PowerCon™ output connector
  - c. Fixture power wiring and accessory power cables shall be rated to support linking of multiple fixtures up to the capacity of a 15A breaker
3. The fixture requires power from non-dim source
4. Power supply outputs shall have self-resetting current limiting protection
5. Power supply shall have power factor correction

## I. LED Emitters

1. The fixture shall contain 4 different LED colors to provide color characteristics as described in below

## J. CALIBRATION

1. Fixture shall be calibrated at factory for achieve consistent color between fixtures built at different times and/or from different LED lots or bins

## K. COLOR

1. The fixture shall utilize an minimum of 40 LED emitters
  - a. These emitters shall be made up of Red, Green, Blue and Lime

## L. DIMMING

1. The LED system shall use 15-bit nonlinear scaling techniques for high-resolution dimming.
2. The dimming curve shall be optimized for smooth dimming over longer timed fades.
3. The LED system shall be digitally driven using high-speed pulse width modulation (PWM)
4. LED control shall be compatible with broadcast equipment in the following ways:
  - a. PWM control of LED levels shall be imperceptible to video cameras and related equipment
  - b. PWM rates shall be adjustable by the user via RDM to avoid any visible interference to video cameras and related equipment

## M. CONTROL AND USER INTERFACE

1. The fixture shall be USITT DMX 512A-compatible via In and Thru 5-pin XLR connectors
2. The fixture shall be compatible with the ANSI RDM E1.20 standard
  - a. All fixture functions shall accessible via RDM protocol for modification from suitably equipped control console
  - b. Temperature sensors within the luminaire shall be viewable in real time via RDM
  - c. Fixtures not offering RDM compatibility, feature set access or temperature monitoring via RDM shall not be compatible
3. The fixture shall be equipped with a 7-segment display for easy-to-read status and control
4. The fixture shall be equipped with a three-button user-interface
5. The fixture shall offer RGB control
6. The fixture shall operate in Regulated mode for droop compensation
7. The fixture shall offer stand-alone functionality eliminating the need for a console

## 2.21 COLOR MIXING PROFILE FIXTURE

## A. General

1. The fixture shall be a color-mixing high-intensity LED illuminator with DMX control of intensity and color. The fixture shall be a ColorSource Spot as manufactured by Electronic Theatre Controls, Inc. or approved equal.
2. All LED fixtures shall be provided by a single manufacturer to ensure compatibility

3. The fixture shall be UL 1573 listed for stage and studio use
4. The fixture shall comply with the USITT DMX-512A standard

B. Physical

1. The unit shall be constructed of rugged, die cast aluminum, free of burrs and pits
2. The following shall be provided:
  - a. Lens secured with silicone shock mounts
  - b. Shutter assembly shall allow for +/-25° rotation
  - c. 20-gauge stainless steel shutters
  - d. Interchangeable lens tubes for different field angles with Teflon guides for smooth tube movement
  - e. Sturdy integral die cast gel frame holders with two accessory slots, and a top-mounted, quick release gel frame retainer
  - f. Rugged steel yoke with two mounting positions allowing 300°+ rotation of the fixture within the yoke
  - g. Positive locking, hand operated yoke clutch
  - h. Slot with sliding cover for motorized pattern devices or optional iris
3. The housing shall have a rugged black powder coat finish
  - a. White or silver/gray powder coat finishes shall be available as color options
  - b. Other powder coat color options shall be available on request
4. Power supply, cooling and electronics shall be integral to each unit.
5. The unit shall ship with
  - a. Theatrical-style hanging yoke as standard
  - b. 5' cable with Neutrik PowerCon™ to choice of connector as standard
  - c. Gate diffuser
  - d. A-size pattern holder
6. Available options shall include but not be limited to:
  - a. Bare-end, Stage-Pin or Twist-lock type-equipped power leads
  - b. PowerCon to PowerCon cables for fixture power linking

- c. Smooth Wash Diffuser for overlapping beams of light from multiple fixtures

**C. OPTICAL**

- 1. The light beam should have a 2-to-1 center-to-edge drop-off ratio
- 2. The unit shall provide, but not be limited to:
  - a. Low glare and beam temperature
  - b. Sharp imaging through a three-plane shutter design
- 3. The unit shall provide, but not be limited to:
  - a. 5, 10, 14, 19, 26, 36, 50, 70 and 90 degree field angles
  - b. High-quality pattern imaging
  - c. Sharp shutter cuts without halation
  - d. Shutter warping and burnout in normal use shall be unacceptable
  - e. Adjustable hard and soft beam edges

**D. ENVIRONMENTAL AND AGENCY COMPLIANCE**

- 1. The fixture shall be ETL and cETL LISTED and/or CE rated, and shall be so labeled when delivered to the job site.
- 2. The fixture shall be ETL LISTED to the UL1573 standard for stage and studio use
- 3. The fixture shall be rated for IP-20 dry location use.

**E. THERMAL**

- 1. Fixture shall be equipped with a cooling fan.
- 2. The fixture shall utilize advanced thermal management systems to maintain LED life to an average of 70% intensity after 20,000 hours of use
  - a. Thermal management shall include multiple temperature sensors within the housing to include:
    - 1) LED array circuit board temperatures
    - 2) Fixture ambient internal temperature
- 3. The fixture shall operate in an ambient temperature range of 0°C (32°F) minimum, to 40°C (104°F) maximum ambient temperature.

**F. ELECTRICAL**

1. The fixture shall be equipped with a 100V to 240V 50/60Hz internal power supply
2. The fixture shall support power in and thru operation
  - a. Power in shall be via Neutrik® PowerCon™ input connector
  - b. Power thru shall be via Neutrik ® PowerCon™ output connector
  - c. Fixture power wiring and accessory power cables shall be rated to support linking of multiple fixtures up to the capacity of a 15A breaker
3. The fixture requires power from a non-dim source
4. Fixtures shall have droop compensation to prevent thermal shift of color or intensity
5. Power supply outputs shall have self-resetting current-limiting protection
6. Power supply shall have power factor correction

**G. LED EMITTERS**

1. The fixture shall contain a minimum of four different LED colors to provide color characteristics as described in the Color Section below
2. All LEDs used in the fixture shall be high brightness and proven quality from established and reputable LED manufacturers.
3. Fixture shall utilize Luxeon® Rebel™ LED emitters

**H. Manufacturer of LED emitters shall utilize an advanced production LED binning process to maintain color consistency.**

1. All LED fixtures (100% of each lot) shall undergo a minimum three-hour burn-in test during manufacturing.
2. LED system shall comply with all relevant patents

**I. CALIBRATION**

1. Fixture shall be calibrated at factory for achieve consistent color and intensity output between fixtures built at different times and/or from different LED lots or bins
  - a. Calibration data shall be stored on the control card as a permanent part of on-board operating system
  - b. All arrays, including replacement arrays shall be calibrated to the same standard to insure consistency
  - c. Fixtures not offering LED calibration shall not be acceptable

**J. COLOR**

1. The fixture shall utilize a minimum of 60 LED emitters
2. The fixture shall utilize a selective mix of Red, Green, Blue and Lime emitters

**K. DIMMING**

1. The LED system shall use 15-bit nonlinear scaling techniques for high-resolution dimming.
2. The fixture shall utilize a Incandescent dimming curve
3. Dimming curve shall be optimized for smooth dimming over longer timed fades.
4. The LED system shall be digitally driven using high-speed pulse width modulation (PWM)
5. LED control shall be compatible with broadcast equipment in the following ways:
  - a. PWM control of LED levels shall be imperceptible to video cameras and related equipment
  - b. PWM shall be capable of being set via RDM to 25,000hz

**L. CONTROL AND USER INTERFACE**

1. The fixture shall be USITT DMX 512A-compatible via In and Thru 5-pin XLR connectors or RJ45 connectors
2. The fixture shall be compatible with the ANSI RDM E1.20 standard
3. The fixture shall offer stand-alone functionality eliminating the need for a console
  - a. Fixture shall ship with 12 preset colors accessible as a stand-alone feature
  - b. Fixture shall ship with 5 sequences accessible as a stand-alone feature
  - c. Each color and sequence can be modified by the end user via RDM
  - d. Fixtures can be linked together with standard DMX cables and controlled from designated master fixture
    - 1) Up to 32 fixtures may be linked
  - e. Fixtures in a stand-alone state shall restore to the settings present prior to power cycling, eliminating the need for reprogramming
  - f. Fixtures without stand-alone operation features described above shall not be acceptable
1. Lens Tubes

- a. The product shall be an optional STANDARD fixed focus lens tube with a field angle of (19° - 26° - 36° - 50°) for use with a Source Four ERS fixture body.
- b. The product shall be retrofit-able into any new or existing Source Four ERS fixture body. The product shall be available as an accessory and not require the purchase of an entire fixture.
- a. The product shall be available in black standard with silver, white and custom colors as options.
- b. Fixtures without stand-alone operation features described above shall not be acceptable

**M. General**

- 1. The fixture shall be a color-mixing high-intensity LED illuminator with DMX control of intensity and color. The fixture shall be a ColorSource® CYC as manufactured by Electronic Theatre Controls, Inc. or approved equal.
- 2. All LED fixtures shall be provided by a single manufacturer to ensure compatibility
- 3. The fixture shall be UL 1573 listed for stage and studio use
- 4. The fixture shall comply with the USITT DMX512-A standard

**N. Physical**

- 1. The fixture shall be contained in a rugged all-metal die-cast housing, free of burrs and pits.
- 2. The housing shall have a rugged black powder coat finish
- 3. Power supply and electronics shall be integral to each unit.
- 4. Fixture housing shall provide built in spill control
- 5. Fixture shall operate directly on the ground or by hanging via yoke
- 6. The unit shall ship with:
  - a. Theatrical-style hanging yoke as standard
  - b. 5' power lead with Neutrik® PowerCON™ to Neutrik® PowerCON™ as standard
- 7. Light output shall be produce an asymmetrical beam

**O. ENVIRONMENTAL AND AGENCY COMPLIANCE**

- 1. The fixture shall be UL and cUL LISTED and/or CE rated, and shall be so labeled when delivered to the job site.
- 2. The fixture shall be UL LISTED to the UL1573 standard for stage and studio use



3. The fixture shall be rated for IP-20 dry location use.

P. THERMAL

1. The fixture shall be natural convection cooled and shall not use a fan
2. The fixture shall utilize advanced thermal management systems to maintain LED life to an average of 70% intensity after 50,000 hours of use

Q. ELECTRICAL

1. The fixture shall be equipped with 100V to 240V 50/60 Hz internal power supply
2. The fixture shall support power in and thru operation
  - a. Power in shall be via Neutrik® PowerCON™ input connector
  - b. Power thru shall be via Neutrik ® PowerCON™ output connector
  - c. Fixture power wiring and accessory power cables shall be rated to support linking of multiple fixtures up to the capacity of a 15A breaker
3. The fixture requires power from non-dim source
4. Power supply shall have power factor correction

R. LED Emitters

1. The fixture shall contain 5 different LED colors to provide color characteristics as described in Section H below.
2. All LEDs used in the fixture shall be high brightness and proven quality from established and reputable LED manufacturers.
  - a. Fixture shall utilize Luxeon® C™ LED emitters
3. Manufacturer of LED emitters shall utilize an advanced production LED binning process to maintain color consistency.
4. LED system shall comply with all relevant patents
5. Fixtures shall have a flicker free mode that will set the LED refresh rate to 25,000 Hz for flicker free operation on camera

S. Warranty

1. The fixture shall be provided with the minimum warranty:
  - a. 5 years full fixture coverage
  - b. 10 years LED coverage

## T. CALIBRATION

1. Fixture shall be calibrated at factory for achieve consistent color between fixtures built at different times and/or from different LED lots or bins
  - a. Calibration data shall be stored in the fixture as a permanent part of on-board operating system
  - b. All arrays, including replacement arrays shall be calibrated to the same standard to ensure consistency
  - c. Fixtures not offering LED calibration shall not be acceptable
2. Fixture shall have droop compensation to overcome thermal droop in the LEDs to maintain output levels and color point.

## U. COLOR

1. The fixture shall utilize a minimum of 42 LED emitters
  - a. These emitters shall be made up of Red, Green, Blue, and Lime

## V. DIMMING

1. The LED system shall use 15-bit nonlinear scaling techniques for high-resolution dimming.
2. The dimming curve shall be optimized for smooth dimming over longer timed fades.
3. The LED system shall be digitally driven using high-speed pulse width modulation (PWM)
4. LED control shall be compatible with broadcast equipment in the following ways:
  - a. PWM control of LED levels shall be imperceptible to video cameras and related equipment
  - b. PWM rates shall be adjustable by the user via RDM to avoid any visible interference to video cameras and related equipment

## W. CONTROL AND USER INTERFACE

1. The fixture shall be USITT DMX512-A compatible via In and Thru 5-pin XLR connectors
2. The fixture shall be compatible with the ANSI RDM E1.20 standard
3. The fixture shall be equipped with a 7-segment display for easy-to-read status and control
4. The fixture shall be equipped with a three-button user-interface
5. The fixture shall offer multiple control modes including but not limited to:

- a. 5 channel (IRGBS)
- 6. The fixture shall operate in Regulated mode for droop compensation
- 7. The fixture shall offer stand-alone functionality eliminating the need for a console

**2.23 POWERCON CABLE**

- A. Powercon cable Shall be a Lex 20Amp 250 VAC powercon, grey inline connector to blue inline Connector #12/3 type SJOOW Cord Extension or equal
- B. Available in 5, 10, and 25 foot lengths.
- C. Required 20 Amp, 208 VAC, 2-Pole, 3-Wire rating.

**2.24 DMX 5 PIN XLR CABLE**

- A. DMX 5 Pin XLR cable shall be a Lex 5-Pin XLR Male (Plug) to 5-Pin XLR Female (Connector), #22/5 DMXPL Shielded Cable, with a Polyurethane Jacket.
- B. Available in 5, 10, and 25 foot lengths.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for installation of the dimmer system. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the dimming system, even though every item may not be specifically mentioned. The contractor shall deliver on a timely basis to other trades any equipment that must be installed during construction.
- B The electrical contractor shall be responsible for field measurements and coordinating physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.
- C The electrical contractor shall install all lighting control and dimming equipment in accordance with manufacturer's approved shop drawings.
- D All branch load circuits shall be live tested before connecting the loads to the dimmer system load terminals.
- E Lighting fixtures and cabling shall be supplied by TLC. Unboxing, hang, and installation of said equipment shall be completed by the owner.

**3.2 RIGGING HOIST AND QUICKTOUCH INSTALLATION**

**A GENERAL**

- 1. Installation of this equipment shall only be performed by ETC approved and factory trained theatrical rigging installers. Installation shall be performed in a workmanlike manner and shall strictly adhere to the standards of these specifications and ETC's installation requirements. Where necessary, the installer may make adjustments to accommodate unforeseen impediments to

installation. The completed work must achieve all electrical, safety and appearance requirements as established in these specifications.

2. Work shall be performed in accordance with OSHA and local codes.
3. On site welding shall only be performed per AWS D1.1 standards and with advanced approval from the architect or Owner's representative.

**B SYSTEM COMMISSIONING**

1. It shall be possible to commission basic functionality of the system without a laptop computer or additional software.
2. A trained installer shall commission the full system via a laptop computer connected via the built-in USB port in the controller. USB connectivity shall not require special USB drivers.
3. Commissioning software shall feature an inspection report generator that allows a step-by-step inspection of the control system. Upon completion, the system shall generate an inspection report in PDF format.

**3.3 MANUFACTURER'S SERVICES**

- A Upon completion of the installation, including testing of load circuits, the contractor shall notify the dimming system manufacturer that the system is available for formal checkout.
- B Notification shall be provided in writing, two weeks prior to the time factory-trained personnel are needed on the job site.
- C No power is to be applied to the dimming system unless specifically authorized by written instructions from the manufacturer.
- D The purchaser shall be liable for any return visits by the factory engineer as a result of incomplete or incorrect wiring.
- E Upon completion of the formal check-out, the factory engineer shall demonstrate operation and maintenance of the system to the owner's representatives. Training shall not exceed four working hours. Additional training shall be available upon request.

**3.4 Submittals:**

- A TLC to provide Consultant with Programming of Architectural System and Control Console 30 days prior to training.
- B TLC to provide Augment3d model and programming in Control Console
- C TLC to provide focus with Consultant prior to training.

END OF SECTION 265561

**SECTION 266100 - ELECTRICAL SYSTEMS COMMISSIONING**

**PART 1 – GENERAL**

**1.1 DESCRIPTION**

- A. General provisions and other electrical systems are specified in other Sections of Division 26.
- B. This Section covers electrical systems commissioning to make the systems ready for safe and satisfactory operation within the design intent. Commissioning shall include, but shall not be limited to, identification, cleaning, documentation, preparation of maintenance and operation manuals, training, preparation of record drawings, lubrication, start-up, check-out, and testing and adjusting of systems.
- C. Commissioning shall be performed throughout construction. Equipment start-up shall be documented as specified herein. Commissioning of the electrical systems shall include the pre-functional and functional performance testing specified herein.

**1.2 QUALITY ASSURANCE**

- A. Electrical systems commissioning shall be the responsibility of the contractor. The engineer will review all findings and make recommendations for changes.
- B. The contractor shall review submittal data for conformance with the requirements of the Project, shall monitor compliance with the requirements specified herein for storage and protection of equipment during construction, shall authorize the initial starting of equipment and systems in a manner to avoid damage to equipment, shall start-up, test and adjust equipment as required.
- C. Refer to ASHRAE Guideline 1-2007, The HVAC Commissioning Process, and Guideline 4-2008, Preparation of Operating and Maintenance Documentation for Building Systems.

**1.3 SUBMITTALS**

- A. As specified in Section 260501, Electrical General and other sections of Division 26.

**PART 2 – PRODUCTS**

**2.1 IDENTIFICATION MATERIALS**

- A. Conduit markers: As indicated in the specifications.
- B. Signs: As indicated in the specifications.

## C. Nameplates and Labels:

1. White core plastic laminate with engraved lettering for normal systems and red core plastic laminated with engraved lettering for emergency systems.
2. Nameplates for individual devices shall have 0.25" high letters.
3. Nameplates for panelboards, lighting control panels, circuit and motor disconnects, and equipment shall have 0.5" high letters.
4. Labels shall have minimum 0.25" high letters.

## PART 3 – EXECUTION

## 3.1 CLEANING

## A. Equipment and Equipment Rooms:

1. Remove dust, dirt, rust, stains, and temporary covers.
2. Foreign matter shall be blown, vacuumed, flushed, or cleaned out of and from equipment, fixtures, raceways, devices, switches, controls and panelboards.
3. Clean and polish identification plates.
4. In equipment rooms, clean equipment, 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.

## 3.2 IDENTIFICATION

## A. General:

1. Identification shall consist of upper-case letters.
2. Where identification is applied to surfaces which require a finish, identification shall be installed after surface has been finished.

## B. Conduit Markers:

1. Install on conduits and raceways exposed or above ceilings at connections to junction boxes, pull boxes, equipment, each side of wall, floor, and roof penetrations, and at 50' intervals along straight runs.
2. On parallel conduits (grouped), markers shall be placed on each conduit in line with each other. Markers shall be positioned in such a manner as to ensure visibility.

## C. Box identification: identify in indelible marker, branch circuit panel and circuit numbers for branch circuits contained within each outlet box, and on the cover of each box. Label on cover shall be P-Touch label.

## D. Cable identification: install cable identification on each communication or signal cable.

## E. Nameplates and Labels:

1. Install engraved nameplates at or on each circuit breaker, circuit and motor disconnect, panelboard, lighting control panels, special apparatus, and communications and signal system, unless equipment is specified herein with its own self-explanatory identification. Text shall match terminology and numbering of the construction documents and submittals as close as practicable, and shall indicate equipment controlled as well as upstream distribution device and branch circuit or feeder designation.
  2. Nameplates shall not cause interference with operation and maintenance of equipment. Attach nameplates with rustproof screws.
- F. Panelboards: install type written directories describing the load served by each circuit. Identify spaces and spares. Install on back of panelboard doors.

### 3.3 OPERATION AND MAINTENANCE DOCUMENTATION PACKAGE

- A. Six copies of operation and maintenance documentation, in hardback 3-ring loose-leaf binders except full size drawings and diskettes, shall cover the electrical systems. Documentation shall include the following: operations and maintenance documentation directory; emergency information; operating manual; maintenance manual; test reports; and construction documents.
- B. The operation and maintenance documentation package shall be submitted as one comprehensive package to the Owner 2 months after submitting and before systems start-up and commissioning, and shall be updated, revised and completed during, and at completion of, commissioning.
- C. Documentation shall be typewritten and shall contain, at a minimum, the following information.
  1. Introduction:
    - a. Project name, contractors' and subcontractors' names, addresses, and telephone and facsimile numbers.
    - b. Index.
  2. Operations and Maintenance Documentation Directory:
    - a. Explanation of the identification system used, including lists of systems, equipment and component identifiers and names.
  3. 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) Power failure.

4. Operating Manual:
  - a. General Information:
    - 1) Building function.
    - 2) Building description.
    - 3) Operating standards and logs.
    - 4) Submittals
    - 5) Engineer's submittal comments.
    - 6) All job observation reports along with contractor's response that all items have been completed.
  - b. Technical Information (All systems specified):
    - 1) System description.
    - 2) Operating routines and procedures.
    - 3) Special procedures.
    - 4) Basic troubleshooting.
5. Maintenance Manual (All systems specified):
  - a. Descriptions (specifications) of the equipment and components.
  - b. Description of function, as applicable: the function of the equipment, procedures before start-up, functional parameters (input, output) at the design load and at part loads, and performance verification procedures.
  - c. Recommended maintenance procedures and their recommended frequency for this Project.
  - d. Recommended list of spare parts, part numbers, and the place(s) from which they can be obtained.
  - e. Original purchase order number; date of purchase; name, address, and the telephone number of the vendor; and warranty information.
  - f. Installation information.
  - g. Any other information needed for the preparation of documents supporting the management of operation and maintenance programs.
6. Test Reports and Certifications:
  - a. Copies of tests and certifications performed during manufacture, construction, and commissioning, including, but not limited to the following:
    - 1) Certification of fire alarm system operation.
    - 2) Certification of Theatrical Lighting Systems.
    - 3) Certification of Audio Visual Systems.
    - 4) Receipt of O&M documentation package.
    - 5) Receipt for instruction of operating personnel.
    - 6) Fire alarm system test report.
7. Construction Documents:
  - a. Record drawings (as built drawings)
  - b. Approved submittals, including revised shop drawings indicating field and as-installed conditions.
  - c. Equipment identification charts and schedules.
  - d. Warranty certificates.



- e. Inspection certificates.
  - f. Commissioning report (pre-functional and function tests).
- D. Submit a receipt signed by the Architect acknowledging receipt of the operation and maintenance documentation package.

### 3.4 RECORD DRAWINGS

- A. Concurrent with the Architect/Engineer's final certificate, submit 2 sets of prints indicating field and as-installed conditions of equipment, systems, conduit and raceways, and incorporating changes made during construction.
- B. A record of field and as-installed conditions shall be maintained at the site, shall be kept current throughout the Project, and shall be used in the preparation of the final record drawings.
- C. Record drawings shall, as a minimum, include:
  - 1. The manufacturer and model number of each piece of equipment.
  - 2. Equipment location and orientation.
  - 3. Raceway and cable tray locations and sizes.
- D. Reproductions of design drawings shall not be used in the preparation of record drawings.

### 3.5 MAINTENANCE

- A. Equipment operated prior to the date of the Architect's final certificate shall be maintained in accordance with manufacturers' recommendations.

### 3.6 INSTRUCTION OF OPERATING PERSONNEL

- A. Conduct formal instruction sessions for operating personnel. Conduct two similar sessions. The first session shall be conducted at the time of start-up and check-out, and the second session shall be approximately 1 month later. Sessions shall be a minimum of twelve hours in duration for basic electrical systems, and as specified herein for other systems and equipment. Sessions shall be conducted at the site.
- B. Prepare and submit a syllabus describing an overview of the program, describing how the program will be conducted, when and where meetings are to be held, names and company affiliations of lecturers, description of contents and outline for each lecture, and recommended reference material and outside reading. Obtain direction from the Owner on which operating personnel shall be instructed in each system.
- C. Sessions shall include:
  - 1. General familiarization and operating procedures for the entire electrical installation.
  - 2. Routine maintenance procedures for equipment.

3. Specific operating and maintenance procedures for:

- a. Electrical panels
- b. Theatrical Lighting Systems
- c. Audio Visual Systems

D. Factory-trained technicians shall give operating and maintenance instructions on the following systems and equipment:

<u>System/Equipment</u>	<u>Minimum Session Duration, hours</u>
Electrical panels & distribution	2
Inverters	2
Fire Alarm System	4
Theatrical Lighting Systems	8
Audio Visual Systems	8

E. Provide DVD format disks of training sessions. Training sessions to be video recorded by contractor.

F. Obtain receipt acknowledging completion of each item of instruction.

**3.8 EQUIPMENT START-UP AND FUNCTIONAL PERFORMANCE TESTS**

A. General: The engineer shall review and approve the Contractor's documentation for the preparation and check-out of equipment for initial start-up. The contractor shall conduct and document the functional performance tests to demonstrate the proper installation, operation and performance of installed equipment and systems. Complete documentation of this testing shall be submitted to, and accepted by, the engineer prior to substantial completion. This documentation shall include the verification of readiness for start-up of each item of equipment on the basis of inspection, including:

- 1. Adjustment of electrical equipment.
- 2. Equipment properly set.
- 3. Wiring and equipment properly connected.
- 4. Controls, safeties, and time switches properly set.
- 5. Electrical overload relays appropriate for load.
- 6. Electrical accessories properly installed and adjusted.

B. Prior to energizing, test cables and wire for continuity, shorts, and circuitry, and correct short circuits, opens, and errors in circuiting.

C. Over-current Protective Device Coordination Study:

- 1. Set field-adjustable devices to dial and tap settings as approved by the engineer.
- 2. Prior to energizing over-current protective devices, test devices for continuity of circuitry and for short circuits. Correct malfunctioning units.
- 3. The contractor shall provide a selective coordination study of all adjustable breakers for the engineer to review during the submittal stages of this project.

- D. Prepare first-run checklist for equipment, perform first-run observations and record findings.
  - 1. Verify direction of motor rotation after final electrical connections.
  - 2. Measure ampere draw of electric motors and compare with nameplate rating and with overload heater ratings.
- E. Start-up equipment and check-out operation in accordance with manufacturer's published procedures and with the procedures specified herein.
  - 1. Submit report on equipment start-up and check-out with data from recorded findings.
- F. Electrical Panels and related equipment:
  - 1. After complete installation, the contractor shall test the following items as a minimum:
    - a. Check for tightness of bolted connections.
    - b. Check for bus bar bracing.
    - c. Check that contact and joint resistances in circuit breakers are within manufacturer's tolerances.
    - d. Check for installation and connection of equipment and circuits, and calibration or adjustment of meters, relays, remote controls, and other devices to ensure operation.
    - e. Test to determine that circuit breaker trip devices are operating and adjusted.
  - 2. The engineer reserves the right to witness the above-described tests, checks, and inspections. Notify the engineer at least 10 days prior to the date scheduled for the tests.
- G. Grounding:
  - 1. Ground resistance shall be measured by the contractor in accordance with IEEE 81-1983. Measurements shall be made with the grounding system isolated from the utility neutral. Results of the tests shall be submitted in a test report. The certified test report shall include the following minimum data:
    - a. Project name, date and location of test.
    - b. Instrument serial number and type used.
    - c. Sketch, showing layout of ground system and locations of test spikes.
    - d. Measured ground resistance.

### 3.9 COMMISSIONING VERIFICATION

- A. Prior to the engineer coming to the site for commissioning verification, the contractor shall provide the following:
  - 1. (ALL systems): The contractor **MUST** provide his punch-list where he has been through the system and has verified that all items are working properly. This list shall include **ALL** items that he found along with a signature and date that each item was completed.
  - 2. (Fire Alarm System Only): Provide a letter signed by the fire alarm vendor that he has tested the fire alarm system and **ALL** items meet the contract documents and NFPA72.
  - 3. (Fire Alarm System Only): Provide documentation from the fire alarm vendor that outlines the testing of **EVERY** smoke detector. This document must list that each device either **PASS** or **FAIL**. Any device that didn't **PASS** must be replaced and the new device tested.
  - 4. (Fire Alarm System Only): No **TROUBLES** or **ALARMS** shall be present on control panel.

- B. Make the following available to the Engineer for commissioning verification:
1. Electrician with hand tools.
  2. Voltmeter, 1% accuracy.
  3. Clamp-on ammeter.
  4. Submittals.
  5. Complete specifications and drawings with bulletins, addenda and revisions.

**ITEMS NEEDED FOR SUBSTANTIAL COMPLETION OBSERVATION BY ENGINEER**

**ELECTRICAL DIVISION**

<b>PROJECT:</b>		<b>FIELD REPORT NO:</b> Ready for Substantial Completion	
<b>CLIENT PROJECT NO:</b>		<b>CLA PROJECT NO:</b>	
<b>DATE:</b>	<b>TIME:</b> N/A	<b>WEATHER:</b> N/A	<b>TEMP RANGE:</b> N/A
<b>SUBMITTED BY:</b> Joseph D. Legge, P.E. ( <i>Electrical Engineer</i> )			
<p>The following items <b>MUST</b> be completed and <b>ALL</b> reports back to the engineer one week prior to scheduling Substantial Completion site observation.</p> <p><b>ELECTRICAL ITEMS:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 1. ALL electrical division contractors <b>MUST</b> submit their job site inspection report listing all items found defective. Each of these items <b>MUST</b> be marked <b>COMPLETED</b> along with the signature and date of the person completing each item. _____ <b>Completed</b></li> <li><input type="checkbox"/> 2. All prior Field Observation Reports by the engineer <b>MUST</b> be submitted back to the engineer with all items marked <b>COMPLETED</b> along with the signature and date of the person completing each item. _____ <b>Completed</b></li> <li><input type="checkbox"/> 3. All Pre-Functional Checklists (furnished by the contractor / supplier) must be completed and submitted back to the engineer with all items marked <b>COMPLETED</b> along with the signature and date of the person completing each item. _____ <b>Completed</b></li> <li><input type="checkbox"/> 4. All Checklists performed by systems vendor must be completed and submitted to the engineer with all items marked <b>COMPLETED</b> along with the signature and date of the person completing each item. _____ <b>Completed</b></li> <li><input type="checkbox"/> 5. The following people <b>MUST</b> be present at substantial completion observation by the engineer:             <ul style="list-style-type: none"> <li><input type="checkbox"/> All electrical division contractors</li> <li><input type="checkbox"/> Fire Alarm System Tech</li> <li><input type="checkbox"/> Vendor / Installers of electrical division systems that can demonstrate that the equipment is working properly.</li> </ul>             _____ <b>Completed</b> </li> <li><input type="checkbox"/> 6. The electrical division contractors must have the following items on hand for the Substantial Completion Site Observation:             <ul style="list-style-type: none"> <li><input type="checkbox"/> Six foot step ladder</li> <li><input type="checkbox"/> Flash Light</li> <li><input type="checkbox"/> Two radios for communicating</li> <li><input type="checkbox"/> Amp &amp; Volt Meter</li> <li><input type="checkbox"/> Contract documents (plans, specs &amp; submittals)</li> <li><input type="checkbox"/> _____ <b>Completed</b></li> </ul> </li> </ul> <p><b>GENERAL ITEMS:</b></p>			

1. Electrical division contractors must have the following items on hand for review at the time of the substantial completion site observation by the engineer:

- "As-Built" drawings
- O&M Manuals

\_\_\_\_\_ **Completed**

2. Electrical division contractors shall understand that training will NOT happen on equipment until the engineer has reviewed equipment / systems and they are found to be in proper working order. Once the engineer as determined that the equipment / systems is ready for training, the owner (school system) must be given a minimum of one week's notice.

\_\_\_\_\_ **Completed**

3. The electrical division contractors shall sign below stating that ALL items required under the scope of division #26 and #27 have been provided / installed and is in proper working order. The signature below also states that ALL items provided under Division #26 have been tested and are in proper working order.

\_\_\_\_\_ **Electrical Division Contractor's Signature of Completion**

\_\_\_\_\_ **Date of Signature**

**SPECIAL NOTE:**

**IF ALL ITEMS MENTIONED ABOVE ARE NOT COMPLETED AND THE CONTRACTOR SCHEDULES A SUBSTANTIAL COMPLETION SITE REVIEW WITH THE ENGINEER, THE ENGINEER WILL BE COMPENSATED BY THE CONTRACTOR AT CLA RETAIL RATES FOR EACH ADDITIONAL VISIT TO THE SITE.**

\_\_\_\_\_ **SIGNATURE AND DATE OF PERSON REQUESTING  
SUBSTANTIAL COMPLETION SITE VISIT BY  
ENGINEER.**

\_\_\_\_\_ **Date of Signature requesting Substantial Completion**

END OF COMMENTS

END OF SECTION 266100

**SECTION 270528 – OWNER FURNISHED COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Architectural Specification Sections, apply to this Section.

**1.2 WORK INCLUDED**

- A. Comply with the provisions of Division 26 Section “Basic Electrical Materials and Methods”.
- B. Provide underground conduit system in accordance with the drawings. Refer to the site plan for conduit routing and sizes. Leave pull cord / rope in all conduits.
- C. Provide conduit, outlet boxes, sleeves and plywood backboards.
- D. Refer to the Systems Coordination Schedule for Owner and Contractor responsibilities.

**1.3 RELATED WORK**

- A. Refer to Division 26 Section “Conductors and Cables”.
- B. Refer to Division 26 Section “Raceways and Boxes”.

**PART 2 - PRODUCTS**

**2.1 EQUIPMENT AND MATERIALS**

- A. Provide 4’ x 8’ x 3/4” fire rated plywood backboards on all walls in telecom rooms. Paint with two coats of flat gray paint.

**PART 3 - EXECUTION**

**3.1 INSTALLATION REQUIREMENTS**

- A. Provide trenching and backfilling required for installation of service.
- B. Leave a nylon pull rope in empty raceway.
- C. Provide 5” square outlet box with cable management with single gang plaster ring for each device. See drawings for locations.

- D. All outlets not used by the owner's vendor shall have a blank cover installed.
- E. All cables concealed in walls or above inaccessible ceilings shall be installed in conduit.
- F. Provide adequate (cable installed plus 50% spare) space in "J-Hook" and cabling rings system for routing and bundling of cabling.
- G. Support for low voltage wiring not required to be in conduit shall be bundled together in a neat manner using approved nylon tie wraps. Bundled cables shall be supported with "J-Hooks" at a maximum of 5'-0" on centers along all corridors. Identify differing cable types with tags at 25'-0" on center.
- H. J-Hook type and requirements to be confirmed with owner. This item **MUST BE COORDINATED** with the OWNER. Provide at minimum Erico CADDY CAT64.
- I. The minimum systems conduit shall be 1 ¼" conduit.
- J. ALL CABLING USED ON THIS PROJECT MUST BE PLENUM RATED.**

END OF SECTION 270528



**SECTION 283111 – ADDRESSABLE FIRE ALARM SYSTEM**

**PART 1 – GENERAL**

**1.1 SCOPE AND RELATED DOCUMENTS**

- A. Furnish and install a complete voice evacuation-type Addressable Fire Alarm System as described herein and as shown on the plans; to be wired, connected, and left in first class operating condition. The system shall use closed loop initiating device circuits with individual zone supervision, individual NAC supervision, incoming and standby power supervision. Include a control panel, manual stations, automatic fire detectors, audio/visual devices, annunciators, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.
- B. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the installation of the Fire Alarm System as shown on the drawings, as herein specified and as required for a complete and operable system.
- C. The requirements of the conditions of the Contract, Supplementary Conditions and General Requirements, apply to the work specified in this section.
- D. The complete installation shall conform to the applicable sections of NFPA-72, Local Code Requirements and National Electrical Code with particular attention to Article 760. Devices shall be added as required to comply with all applicable codes. No change orders will be provided for additional devices.
- E. Additionally, the entire installed system and all integrated system operations shall be within the guidelines of the IBC 2018 Code.
- F. The work covered by this section of the specifications is to be coordinated with the related work as specified elsewhere under the project specifications.
- G. The voice evacuation system shall be provided with microphone for making announcements.

**1.2 REFERENCES**

- A. NFPA 72, the National Fire Alarm Code
- B. NFPA 101 - Life Safety Code®

**1.3 REGULATORY REQUIREMENTS**

- A. Equipment: All devices, combinations of devices, notification appliances, and equipment, shall be listed for the protective signaling purpose for which they are used and shall be installed in compliance with applicable codes and standards.

- B. Type of System: The control panel shall be Listed for power-limited applications per NEC 760 and for compliance with the National Fire Protection Association Standards NFPA 72; for Local, Auxiliary, Remote Station, and/or Proprietary fire protective signaling systems.
- C. Type of Service: The control panel shall be Listed for the applicable types of service, i.e.; Manual Alarm, Automatic Alarm, Waterflow Alarm and/or Sprinkler Supervisory Service.
- D. Type of Signaling: The control panel shall be Listed for the applicable types of signaling methods used, i.e.; Zone Coded, Non-Coded, March Time and/or Digital Alarm Communicator (DACT) Signaling.

#### 1.4 SYSTEM DESCRIPTION

- A. Fire Alarm System: Provide a complete, supervised, power-limited, fire detection and evacuation system.
  - 1. All equipment herein specified is that of Siemens. or approved equal and depicts the type and quality of the equipment to be furnished. Refer to Submittals, Products/Manufacturers, and Products/Substitutions sections in this specification for further information and qualifications.
- B. System Supervision: The fire protective signaling system shall be an electrically supervised system, which shall monitor the integrity of circuit conductors and power supplies. Performance of fire protective signaling system circuits shall be in accordance with Class B (Style B) operation for Initiating Device Circuits, and Class B (Style Y) operation for initiating service and circuits and operation for Notification Appliance Circuits. Remote annunciator LEDs and associated wiring and remote emergency control wiring shall be supervised; whereas, an open condition in the circuit shall cause a trouble indication at the control panel.
- C. The fire alarm control panel shall allow for loading or editing special instructions and operating sequences as required. The system is to be capable of on-site programming to accommodate facility expansion, building parameter changes, or changes as required by local codes. All software operations are to be stored in a non-volatile, programmable memory resident within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
- D. Initiation circuits shall be individually configurable on-site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching circuit, or a alarm verification circuit.
- E. The control panel shall provide a minimum of 4 amps of power for notification appliances and auxiliary devices. Provisions shall be available for expanding the standard power to provide an additional 5 amps of power for notification appliances and auxiliary devices.

#### 1.5 OPERATION

- A. Under normal condition, the front panel shall display a "SYSTEM NORMAL" message and the current time and date.

- B. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.
- C. The following three characteristics relative to an abnormal condition shall be displayed simultaneously in alphanumeric format. Information shall include:
  - 1. Custom location label (40 characters minimum).
  - 2. Type of device (i.e. smoke, pull station, waterflow).
  - 3. Status (i.e. alarm, trouble).
- D. Pressing the appropriate acknowledge button shall acknowledge the alarm or trouble condition. The acknowledge functions may be passcode protected.
- E. After all the points have been acknowledged, the LEDs shall glow steady and the panel audible signal shall be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated. The first 10 fire alarm zones shall be displayed simultaneously in chronological order.
- F. Alarm Silencing
  - 1. Pressing the "Alarm Silence" button shall cause all notification appliances programmed for "On-Until-Silenced" to be deactivated. A separate panel mounted yellow LED shall illuminate to indicate the alarm silenced mode.
- G. System Reset
  - 1. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied. The display shall step the user through the reset process with simple English language messages.
  - 2. Should an alarm condition continue to exist, the system shall remain in an abnormal state. System control relays shall not reset. The panel audible signal and the Alarm LED shall be on. The display shall indicate the total number of alarms and troubles present in the system along with a prompting to review the points. These points shall not require acknowledgment if they were previously acknowledged.
- H. History Logging.
  - 1. The control panel shall have the ability to store a minimum of fifty (50) events in an alarm log plus a minimum of one hundred (100) events in a separate trouble log. These events shall be stored in a battery protected random access memory (RAM). Real time and date shall accompany all history event recording.
  - 2. History logs shall be capable of being viewed separately or shall be selectable for viewing as a combined history log that displays both alarm and trouble events in chronological order.
- I. Walk Test System Testing

1. The system shall be capable of being tested by one person. While in the test mode, the system shall display a trouble condition.
  - a. While in the walk test mode, the activation of an initiating device shall be silently logged as an alarm in the historical log. The panel shall automatically reset after logging the alarm.
  - b. The momentary disconnection of an initiating device or notification appliance shall be silently logged as a trouble condition in the historical log. The panel shall automatically reset itself after logging of the trouble condition.
  - c. Walk Test of ground fault circuit testing shall be verified by operating the Notification Appliances for 4 seconds.

**J. Active Status Reminder**

1. Should any Alarm, Supervisory, or Trouble condition be present within the system and the audible signal silenced, the local tone alert shall resound every 8 hours (each change of work shift) to act as a reminder that the fire alarm system is not 100% operational.

**K. Access Levels**

1. There shall be a minimum of four (4) access levels. Passcodes shall consist of up to four (4) digits. Changes to passcodes shall only be made by authorized personnel.
2. Access to a level shall only allow the operator to perform all actions within that level and all actions of lower levels, not higher levels.
3. The following keys/switches shall have access levels associated with them:
  - a. Alarm Acknowledge
  - b. Supervisory Acknowledge
  - c. Trouble Acknowledge
  - d. Alarm Silence
  - e. System Reset

**1.6 ALARM SEQUENCE**

- A. The system alarm operation subsequent to the alarm activation of any manual station, automatic detection device, or sprinkler flow switch is to be as follows:
  1. All audible alarm notification appliances shall sound with the following characteristics:
    - a. Continuous fire alarm signal until silenced by the alarm silence switch at the control panel.
  2. All visible alarm notification appliances:

- a. Xenon Strobes shall display a continuous synchronized pattern until the system is reset.
  3. Audio / Visual devices shall all operate.
  4. A supervised signal to notify the local fire department or an approved central station is to be activated. The type of "city connection circuit" is to be on-site configurable to provide either a "reverse polarity", "local energy", or dry contact connection. The contractor shall coordinate exact connection required and included in this project.
  5. All air handling units and other HVAC fans serving the affected area shall be shut-down via duct mounted smoke detector, definite purpose contactors and/or area smoke detectors. Refer to mechanical sequences of operation and E300 series sheets for units to be shut-down. Provide appropriate devices to shut-down units and provide wiring to the HVAC units for termination by the mechanical contractor. Coordinate all requirements with mechanical contractor and provide all parts, wiring, and programming as required. **Duct mounted smoke detectors located above ceilings shall be provide with remote ceiling mounted test switch with alarm indicator light.**
  6. An alarm is to be displayed on the panel display as defined in the OPERATION section of these specifications. The alarm LED shall flash on the control panel until the alarm has been acknowledged at the control panel. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone after acknowledged shall flash the alarm LED on the control panel and the panel display shall show the new alarm information.
  7. A pulsing alarm tone shall occur within the control panel until acknowledged.
- B. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the panel shall reset the activated detector and wait for a second alarm activation. If, within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute the system is to resume normal operation. The Alarm Verification is to operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately.
- C. The control panel is to have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.
1. The activation of any standpipe or sprinkler valve tamper switch shall activate the system supervisory service audible signal and illuminate the LED at the control panel. Refer to fire protection drawings for exact location of ALL devices. Provide connection as requires.
  2. A waterflow indicator/sprinkler supervisory switch combination IDC type shall be selected allowing a single pair of wires to monitor both conditions. Waterflow monitor shall have priority over sprinkler supervisory monitoring. Refer to fire protection drawings for exact location of ALL devices. Provide connection as requires.
  3. Restoring the valve to the normal position shall cause the Supervisory Service LED to extinguish, indicating restoration to normal.

## 1.7 SUPERVISION

- A. There shall be sprinkler supervisory initiation device circuits for connection of all sprinkler valve tamper switches to perform the Supervisory Service Operation. This independent initiation circuit shall be labeled Supervisory Service and shall differentiate between tamper switch activation and wiring faults.
- B. There shall be independently supervised and independently fused NACs for audible notification appliances. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
- C. Each independently supervised circuit shall include a discrete panel readout to indicate disarrangement conditions per circuit.
- D. The incoming power to the system shall be supervised so that any power failure must be audibly and visibly indicated at the control panel and the remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present.
- E. 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 panel.
- F. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes. Restoration of a disabled circuit displays the status of the circuit and initiates a count down timer allowing the operator to "Abort the Enable" to prevent unwanted activation of notification appliances, off-premise reporting, and emergency controls.
  - 1. The count down timer shall be programmable from the front panel to be from 0 to 60 minutes.

## 1.8 POWER REQUIREMENTS

- A. The control panel shall receive 120 VAC power via a dedicated circuit.
- B. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of eight (8) hours. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
- C. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.
- D. All exterior circuits and main power supplies shall have TVSS protection.

## 1.9 QUALIFICATIONS

- A. Manufacturer: The Manufacturer shall be a nationally recognized company specializing in fire alarm systems. This organization shall employ factory trained and NICET certified technicians, and shall maintain a service organization within 100 miles of this project location.
- B. Installer: The installation organization shall be a company specializing in the installation of fire alarm systems. This organization shall have a minimum of 5 years experience with installation of fire protective signaling systems.

#### 1.10 SUBMITTALS

- A. Submit Manufacturer product data sheets for all proposed devices and equipment.
- B. Provide wiring diagrams, equipment ratings, dimensions, and finishes for all proposed devices and equipment.
- C. If submittals are found not to conform with the performance, type and quality of products as well as all other requirements of these specifications; the Contractor shall be required to resubmit. Approval of the submittals by the Engineer shall, in no case, relieve the Contractor of the responsibility to meet the requirements of this specification.
- D. Provide point-to-point drawings and battery calculations. Submittal will be REJECTED if these items are not provided.
- E. **ALL submittals shall be submitted and approved by the local Fire Marshall BEFORE any equipment can be ordered or installed.** It shall be the contractor's responsibility to provide all corrections noted by the Fire Marshall. These changes must be made at no additional cost to the project.

#### 1.11 PROJECT RECORD (AS-BUILT) DRAWINGS

- A. The Contractor shall provide and maintain on the site an up-to-date record set of approved shop drawings.
- B. Record drawings shall include location of end-of-line device locations.
- C. Upon completion of the work, and final acceptance by the local authority, the Contractor shall submit record drawings to the Engineer.

#### 1.12 OPERATION AND MAINTENANCE DATA

- A. Submit Manufacturer data sheets for all equipment installed.
- B. Include operating, installation, and routine maintenance instructions.
- C. Include Manufacturer letter stating the date of installation on which the system is operational and meets all applicable codes.

#### 1.13 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.

## 1.14 EXTRA MATERIALS

- A. Provide spare parts (one smoke detector, pull station and A/V device).

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Siemens

## 2.2 SUBSTITUTIONS

- A. Written approval must be obtained from engineer one week prior to bid.

## 2.3 FIRE ALARM CONTROL PANEL

- A. Provide and install a Siemens Desigo XLS Firefinder Fire Alarm Control Panel. Construction shall be modular with solid state, microprocessor-based electronics.
- B. Primary Keys & Panel Display
  - 1. The Control Panel's display shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there should be keypad activity.
- C. The fire alarm control panel cabinet shall provide the following features:
  - 1. The cabinet shall be equipped with lock.
  - 2. To facilitate installation, the cabinet shall provide:
    - a. Built-In depth gauges for drywall installation.
    - b. Built-In knockouts for mounting holes and wiring conduit entrance.
    - c. A built-in trim band to allow FLUSH mounting into rough cut wall openings.

## 2.4 INITIATING DEVICES

- A. Pull Station: Siemens Model HMS-D, SB-5R, STI-1130 – **Provide a clear plastic cover with an integral alarm to sound when cover is removed.**
- B. Smoke Detector – Ceiling Mounted: Siemens Model FDO421, DB-11



C. Heat Detector – Ceiling Mounted: Siemens Model FDT421, DB-11

D. Smoke Detector – Duct Mounted: Siemens Model FDBZ492-HR, FDO421

2.5 FIRE ALARM WIRE AND CABLE

A. As required by Siemens.

2.6 FIRE ALARM WIRE AND CABLE

A. As required by Siemens

**B. ALL F/A CABLING TO BE INSTALLED IN CONDUIT**

2.7 AUDIO / VISUAL DEVICE:

A. Siemens Model: SE-MC-R, SPSSB

2.8 VISUAL ONLY DEVICE:

A. Siemens Model: ZR-M-R, SHBBS

2.9 REMOTE ANNUNCIATOR:

A. Siemens Model: SSD-C

2.10 **(EDIT)** CARBON MONOXIDE DETECTORS

- A. The CO detector shall be a special color that is clearly different from other fire alarm system smoke detector devices. The preferred color is RED or YELLOW. The new CO detector will be required to annunciate on the control and annunciator panels as CO Detectors when in alarm or trouble.
- B. When in alarm, the fire alarm system must emit a different tone/sound if system is a non-voice evacuation type panel. If the fire alarm control panel is a voice evacuation type device it shall emit a separate message that states a CO message. The exact message shall be coordinated with the university and recorded and added to the system as required.
- C. The CO detector must be able to report a trouble and alarm signal as follows:
- a. ALARM SIGNAL – CO Alarm Signal will be sent when levels reach the values shown below:
- 30ppm no less than 30 days
  - 50ppm for 6 to 8 hours
  - 70ppm 60 to 240 minutes

- 150ppm 10 to 50 minutes
  - 400ppm 4 to 15 minutes
- b. TROUBLE SIGNAL – CO Trouble Signal will be sent when levels reach 80% of the alarm values – see below:
- 25ppm no less than 30 days
  - 40ppm 6 to 8 hours
  - 55ppm 60 to 240 minutes
  - 120ppm 10 to 50 minutes
  - 320ppm 4 to 15 minutes

When a CO detector is in alarm, it shall send a general alarm signal (with special tone or message as outlined) to evacuate the building through the fire alarm system. A signal will also be sent to turn natural gas OFF at the main meter for each building. A solenoid type valve will be added to each main gas meter for this purpose. This valve will receive a signal from the fire alarm system when the CO detector goes into alarm ONLY. Coordinate the exact voltage and shut-down method required for this device. The contractor shall be required to provide all hardware, software, power circuits, conduit, wiring and related items as required to make the systems function as described above.

- D. Carbon Monoxide (CO) detectors will be placed at all CO emitting equipment. This includes gas water heaters, boilers, dryers, cooking equipment and related items.
- E. Ceiling mounted Carbon Monoxide (CO) detectors will also be placed in corridor ceilings outside dorm rooms.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate Subcontractors.
- B. The contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
- C. All junction boxes shall be RED in color as manufactured by Cooper, Raco, or equal. Wiring color code shall be maintained throughout the installation.
- D. Conductors must enter each device, terminate on the device, then leave the device. NO "T" taps will be allowed. There shall be NO MORE conductors in the box with the device than the single cable entering and exiting the box. Multiple conductors and splices will NOT be allowed.
- E. Provide and install the system in accordance with the plans and specifications, all applicable codes, and the Manufacturer's recommendations. All wiring shall be installed in accordance with all applicable codes and standards. Upon completion of installation, the Contractor shall so certify, in writing, to the Owner and the General Contractor.

- F. The fire alarm system shall send a signal to the access control system to open ALL doors when the system is in alarm. **The contractor shall coordinate with the door hardware vendor to provide ALL wiring, relays, power supplies and other components required. No change order will be processed to provide fire alarm connectivity to access controlled doors.**

### 3.2 FIELD QUALITY CONTROL

- A. The completed fire alarm system shall be fully tested in accordance with NFPA-72, by the fire alarm system vendor. This system MUST be completely functional (no troubles or alarms on the system) before the engineer will come to the site for commissioning. Once this is done, the fire alarm system vendor must provide all documentation outlined in NFPA 72 for documenting tests to the engineer. Once this is done, the fire alarm vendor must certify in writing that the fire alarm system is functioning per the contract documents and NFPA 72. The installer will then be required to test the system again in the presence of the Engineer and the Local Fire Marshal.
- B. The Manufacturer shall provide on-site technical installation support.
- C. The electrical and fire alarm system contractors will be required to test all components of the fire alarm system, whether he is responsible for installing them, or not. It should be noted that this will take multiple trips to the site for reviews. Refer to this specification for information associated with testing of this system. Once the contractor has tested and documented ALL fire alarm system devices and associated equipment as working properly with NO TROUBLES or ALARMS showing up on the fire alarm control panel, he may then request a time for the following tests (Fire Alarm and related contractors noted in specs 266100 MUST be present at all of these tests):
- Testing with ALL contractors that have devices that are monitored by the fire alarm system. This will take multiple trips.
  - Testing with the 3rd part fire alarm testing agent, engineer and/or commissioning agent. If all systems do not pass, this could take multiple trips to the site.
  - Testing with the fire marshal. If all systems do not pass, this could take multiple trips to the site.

### 3.3 ON SITE TRAINING

- A. The vendor shall provide a minimum of two (2) hours of on-site training for the facility users. This training shall be video taped by the contractor. Provide a DVD of training.
- B. A list of the persons that attend training shall be included in the O&M manuals.

### 3.4 CONDUIT

- A. **The entire fire alarm system shall be installed in RED conduit as manufactured by Allied, Wheatland and Republic. Compression fittings are permitted to be standard EMT.**

### 3.5 CEILING MOUNTED SMOKE DETECTORS

- A. Corridor smoke detectors shall NOT exceed 30 feet on center.

- B. Detectors shall not be located within 3 feet of supply grilles.

**3.6 MONITORING SERVICE FOR FIRE ALARM SYSTEM**

- A. The contractor shall include in his bid the cost of a monitoring service for this facility for one (1) year from the date of acceptance of the building. All cost shall be included in the contractors bid. The school system shall have the right to extend this monitoring service or cancel this service at the end of the one (1) year monitoring service.

**3.7 TELEPHONE CABLES REQUIRED FOR MONITORING**

The contractor shall provide two (2) telephone lines for monitoring of the fire alarm system. Coordinate exact location of lines with the owner and extend lines to the new fire alarm system control panel and connect as required. One line must be a dedicated outside line (can not go through PBX switch). Telephone lines used for monitoring of fire alarm system must be installed in conduit.

**3.8 TESTING OF FIRE ALARM SYSTEM (EDIT AS REQUIRED)**

- A. The contractor will be required to test the fire alarm system with a tester equal to Siemens...

END OF SECTION 283111

- A. **The work required by this section is to be included as an allowance.** The Electrical Contractor shall include in his bid, an allowance of \$140,000.00 (One Hundred Forty Thousand Dollars) to procure the Audio Visual Systems described herein and further illustrated on Division 26 drawings. Selection of the appropriate Audio Visual Contractor shall be made on a “Best Value” basis for the Owner once the project has been awarded. The selection process will include representatives of the Owner and Design Professionals.