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**BIDDING DOCUMENTS**  
**FOR**  
**OWOSSO CITY HALL IMPROVEMENTS**

**CITY OF OWOSSO**  
**OWOSSO, MICHIGAN**

Prepared By:  
SPICER GROUP, INC.  
SAGINAW, MICHIGAN  
March 4, 2025

**Plans Included:**  
DA-1529 – 14 Sheets

Project I.D. Number: 137560SG2024

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## TABLE OF CONTENTS

Division	Section Title	Pages
<b>SPECIFICATIONS GROUP</b>		
	BIDDING DOCUMENTS	1
<i>General Requirements Subgroup</i>		
<b>DIVISION 01 - GENERAL REQUIREMENTS</b>		
011000	SUMMARY	1
012000	PRICE AND PAYMENT PROCEDURES	4
012500	SUBSTITUTION PROCEDURES	2
013000	ADMINISTRATIVE REQUIREMENTS	4
013300	SUBMITTAL PROCEDURES	6
014000	QUALITY REQUIREMENTS	3
015000	TEMPORARY FACILITIES AND CONTROLS	6
016000	PRODUCT REQUIREMENTS	2
017000	EXECUTION AND CLOSEOUT REQUIREMENTS	6
<i>Facility Construction Subgroup</i>		
<b>DIVISION 03 - CONCRETE</b>		
031000	CONCRETE FORMING AND ACCESSORIES	6
032000	CONCRETE REINFORCING	5
033000	CAST-IN-PLACE CONCRETE	9
033900	CONCRETE CURING	2
<b>DIVISION 04 - MASONRY</b>		
040100	MAINTENANCE OF MASONRY	5
040500	MASONRY MORTARING AND GROUTING	4
042000	UNIT MASONRY	6
<b>DIVISION 05 - METALS</b>		
055200	METAL RAILINGS	5
<b>DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES</b>		
061000	ROUGH CARPENTRY	5
062000	FINISH CARPENTRY	9
<b>DIVISION 07 - THERMAL AND MOISTURE PROTECTION</b>		
07190	VAPOR AND AIR BARRIERS	2
072113	BOARD INSULATION	4
<b>DIVISION 09 - FINISHES</b>		
099000	PAINTING AND FINISHES	9

*Facility Services Subgroup*

**DIVISION 22 - PLUMBING**

220000	PLUMBING	5
226300	NATURAL GAS PIPING	7

**DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**

230000	HVAC	5
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	14
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT	6
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC	16
230700	HVAC INSULATION	10
230901	DIGITAL TEMPERATURE CONTROL SYSTEM	25
230923	TEMPERATURE CONTROL SYSTEM	22
233100	HVAC DUCTS AND CASINGS	8
233300	AIR DUCT ACCESSORIES	4
237400	PACKAGED OUTDOOR HVAC EQUIPMENT	6
238126	SPLIT-SYSTEMS AIR-CONDITIONERS	

**DIVISION 26 - ELECTRICAL**

260000	ELECTRICAL GENERAL PROVISIONS	11
260501	SELECTIVE ELECTRICAL DEMOLITION	3
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	8
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	6
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	10
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS	10
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS	6
262416	PANELBOARDS	6
262813	FUSES	4
263213	ENGINE GENERATORS	8

**DIVISION 28 - ELECTRONIC SAFETY AND SECURITY**

283100	EXTENSION OF THE EXISTING FIRE DETECTION AND ALARM SYSTEM	8
--------	---	---

*Site and Infrastructure Subgroup*

**DIVISION 31 - EARTHWORK**

310513	SOILS FOR EARTHWORK	3
311000	SITE CLEARING	3
312213	ROUGH GRADING	5
312316	EXCAVATION	5
312323	FILL	4
313221	FILTER FABRIC	6
313521	SLOPE PROTECTION AND EROSION CONTROL	6

**DIVISION 32 - EXTERIOR IMPROVEMENTS**

329219	SEEDING	7
323113	CHAIN LINK FENCES AND GATES	3
329119	LANDSCAPE GRADING	6

END OF TABLE OF CONTENTS

**NOTICE TO BIDDERS**  
**OWOSSO CITY HALL IMPROVEMENTS**  
**FOR THE CITY OF OWOSSO, MICHIGAN**

Sealed proposals will be received by the city of Owosso for the

**OWOSSO CITY HALL IMPROVEMENTS PROJECT**

and should be addressed to:

Terri Sinn – Bid Coordinator  
City of Owosso  
301 W. Main Street  
Owosso, Michigan 48867

**Major items include:** Demo of existing underground storage room, generator & (4) rooftop units. Waterproofing, infill, new housekeeping pad, fence and landscaping in place of removed room. (4) new rooftop units with (1) new roof railing. New building management system. Numerous add alternates including new IT room air conditioning and various electrical upgrades.

**Timeline:** The proposed construction timeline for the Earth work, rooftop unit replacements, temperature controls system and gas piping shall be completed prior to fall 2025 heating season. The electrical scope which includes long lead-time equipment including the generator may require extending beyond that. See page 6 for more details and if there are concerns with this proposed timeline, include comments in bid form.

A recommended Pre-Bid Walk Thru will take place on at **11:00 a.m. on Thursday, March 13, 2025** beginning in the Council Chambers at 301 W. Main Street, Owosso, MI 48867.

Bids will be accepted until **3:00 p.m. on Tuesday, March 25**. At that time, bids will be publicly opened in the Council Chambers at 301 W. Main Street, Owosso, MI 48867. This bid will be considered "All or None".

"All or None" means that bidders are required to submit pricing for all items requested. Any proposal received that does not meet this requirement will be disqualified. If said bid is not listed as "All or None" the City reserves the right to split said bid to our best benefit.

All bids must be in writing and must contain an original signature by an authorized officer of the firm. Electronic bids (i.e., telephonic, fax, email, etc.) are **NOT** acceptable.

All bids must be accompanied by a Bid Bond for a sum of not less than 5% of the total bid and shall be made payable to the city of Owosso. This amount shall be forfeited in the case of failure on the part of the successful bidder to sign a contract and furnish satisfactory bonds as required within ten (10) consecutive calendar days after the acceptance of the bid by the city of Owosso.

The bidder agrees that if the city accepts their proposal, the bidder will, within 10 consecutive calendar days after receiving notice of this acceptance, enter into a contract to furnish all labor, equipment and tools necessary to execute the work at the unit prices named in the bid proposal and will furnish the surety for performance, for one hundred percent (100%) of this bid, which shall be accepted and approved by the city.

All bids shall clearly contain on the outside of the **sealed** envelope in which they are submitted:

**OWOSSO CITY HALL IMPROVEMENTS**

Electronic copies of the plans and specifications will be available on Quest, with a direct link provided on the Bidding tab at [www.spicergroup.com](http://www.spicergroup.com).

The city reserves the right to accept any proposal; or to reject any proposal; to waive irregularities in a proposal; or to negotiate if it appears to be in the best interest of the city of Owosso.

## **INQUIRIES/ADDENDUMS**

Addendums will be available on Quest.

All inquiries regarding this bid request must be submitted to Andrew Farron and received at least seven (7) calendar days prior to the submission and shall be received in, and responded to, in writing, by e-mail to: [andrew.farron@spicergroup.com](mailto:andrew.farron@spicergroup.com). Please email Andrew Farron or call 231-499-9400 to arrange a field inspection if you are unable to make the pre-bid meeting.

## INSTRUCTIONS TO BIDDERS

1. Each proposal must be signed by the bidder with his usual signature. Bids by partnerships should be signed with the partnership name by one of the members of the partnership or by an authorized representative, followed by the signature and title of the person signing. Proposals by corporations must be signed with the name of the corporation, followed by the signature and designation of the president, vice-president or person authorized to bind it in the matter. **Any paperwork not filled out properly or signed will cause the bid to be considered non-responsive and shall be rejected by the city.**
2. Proposals, to receive consideration, must be received prior to the specified time of opening and reading as designated in the invitation.
3. Bidders are requested to use the proposal form furnished by the city when submitting their proposals. Envelopes must be **sealed** when submitted and clearly marked on the outside indicating the name of the bid.
4. Proposals having and erasures or corrections thereon may be rejected unless explained or noted over the signature of the bidder.
5. References in the specifications or description of materials, supplies, equipment, or services to a particular trade name, manufacturer's catalog, or model number are made for descriptive purposes to guide the bidder in interpreting the type of materials or supplies, equipment, or nature of the work desired. They should not be construed as excluding proposals on equivalent types of materials, supplies, and equipment or for performing the work in a manner other than specified. However, the bidders' attention is called to General Condition seven (7).
6. Proposals should be mailed or delivered to: Terri Sinn – Bid Coordinator, Owosso City Hall, 301 W. Main Street, Owosso, MI 48867.
7. Special conditions included in this inquiry shall take precedence over any conditions listed under General Conditions or Instructions to Bidders.
8. Insurance coverage – The winning bidder, prior to execution of the contract, shall file with the city copies of completed certificates of insurance naming the city of Owosso as an additional insured party, as evidence that the contractor carries adequate insurance satisfactory to the city.
9. The city of Owosso has a local preference policy for the purchase of goods and services. The policy in part states: *A business located within the city limits and paying real or personal property taxes to the city of Owosso will be granted a six percent (6%) bid advantage or \$2,500, whichever is less, over a business located outside Shiawassee County. A business located outside the city limits but within Shiawassee County and paying property taxes to the county will be granted a three percent (3%) bid advantage or \$2,500, whichever is less, over a business located outside Shiawassee County. The preference also applies to subcontractors performing twenty-five percent (25%) or more of the work of a general contract.*
10. **The following items must be included with the bid response:**
  - a. **Bid Proposal**
  - b. **Signature Page & Legal Status/ Acknowledgement of Addendum(s)**
  - c. **Local Preference Affidavit (if applicable)**

- d. **W-9 Request for Taxpayer ID No. and Certification**
- e. **Familial and Iran Docs**
- f. **5% Certified Check or Bid Bond**

11. Bid Alternate Descriptions:

- a. Base Bid – Underground room infill, new pad / landscaping, new temperature controls system, new rooftop units, new generator, new transfer switch, new transformer and associated disconnects, and re-configured grounding electrode system.
- b. Add. Alternate #1 – Add new IT Room Air Handling Unit (AHU-1) and associated new Condensing Unit (CU-1) on the roof, including new electrical main disconnect #MD-A6, new feeder conductors and conduit, and electrical connections.
- c. Add. Alternate #2 – Disconnect and replace existing 1Ø electrical Main Distribution Panel (#MDP-B) as required. Field verify existing feeder conductors that are to remain and be reconnected.
- d. Add. Alternate #3 – Replace designated existing electrical branch panel feeder conductors. Disconnect, remove, and discard existing designated feeder conductors within existing electrical conduit that is to be reused. Provide new feeder conductors and associated electrode grounding conductors (EGC) as shown to reconnect existing electrical panels as required.
- e. Add. Alternate #4 – Disconnect and replace existing designated existing Electrical Panels #P3, #P4, #P5, #P6, #P7, & #EP1 as required. Field verify and reconfigure/extend all existing branch circuit conductors that are to remain. Include the reconfiguration of the electrical feeder conductors for the 4 – existing electrical panels #P5, #P6, #P7, and #EP1 that are to be combined into 2 – new electrical panels as shown.
- f. Add. Alternate #5 – Field coordinate with Consumers Energy to eliminate the existing 1Ø electrical service. Includes replacement of the designated existing 3Ø main disconnects with a new electrical 3Ø Main Distribution Panel (#MDP-A), and the replacement of the existing 1Ø electrical Main Distribution Panel (#MDP-B) with a new 3Ø electrical Main Distribution Panel as shown.



## BID PROPOSAL

### Owosso City Hall Improvements Project

TO: THE CITY OF OWOSSO (HEREINAFTER CALLED THE “CITY”)

Bidder must provide pricing for each item listed. If additional pricing elements are being offered by the bidder, they are to be listed under “other services/items offered.”

The undersigned, having examined the bid proposal forms and specifications, does hereby offer to listed below at the following prices to wit:

**Bid Items 1-6:**

Item	Description	Total Price
1	<u>Base Bid</u> – Underground room infill, new pad / landscaping, new temperature controls system, new rooftop units, new generator, new transfer switch, new transformer and associated disconnects, etc. as shown.	\$
2	<u>Add. Alternate #1</u> – Add new IT Room Air Handling Unit (AHU-1) and associated new Condensing Unit (CU-1) on the roof, including new electrical circuits and connections.	\$
3	<u>Add. Alternate #2</u> – Disconnect and replace existing 1Ø electrical Main Distribution Panel (#MDP-B) as required.	\$
4	<u>Add. Alternate #3</u> – Replace designated existing electrical branch panel feeder conductors.	\$
5	<u>Add. Alternate #4</u> – Replace 6 – existing electrical branch panels with 4 – new electrical branch panels.	\$
6	<u>Add. Alternate #5</u> – Upgrade the existing 3Ø and eliminate the existing 1Ø electrical service as shown.	

Bidder’s Initial \_\_\_\_\_

**BID TOTAL (Bid Items 1-5)**

\_\_\_\_\_ (use words)

\$ \_\_\_\_\_ (use figures)

**VARIANCE FROM SPECIFICATIONS:** If the bidder is unable to comply with the specifications as outlined, the bidder shall clearly note these variations from the specifications. The bidder may also propose additions to these specifications for the city to consider, but the costs associated with these additions shall be stated separately.

If the work is not complete on or before the date set for completion or any extension as explained below, the Contractor shall pay the city liquidated damages of **\$200** a calendar day until the work is satisfactorily completed. Liquidated damages for delay may be deducted from payments due the contractor or may be collected from the Contractor or the Contractor's surety. Additionally, if the facility is not occupiable due to disruptions to heat, utilities or operations, the Contractor shall pay the city liquidated damages of **\$1000** a calendar day until the city can re-occupy the building. Coordinating the rooftop unit replacements around heating season and coordinating electrical shutdowns on evenings, weekends or within the allowable 6-hour shutdown time provided by the City's IT department (housed within this building).

The undersigned agrees that if the city accepts this proposal, Contractor will, within 10 consecutive calendar days after receiving notice of this acceptance, enter into a contract to furnish all labor, equipment and tools necessary to execute the work at the unit prices named in the bid proposal. Contractor will furnish the surety for performance, for 100% of this bid, which shall be accepted and approved by the city.

The undersigned agrees that if the city accepts this proposal, Contractor will start this project no sooner than **May 1, 2025** and will substantially complete the entire work under this contract by **June 1, 2026**, excluding the replacement Generator scope which shall be substantially complete by **November 1, 2026**. This schedule may be modified due to lead times weather considerations, etc., only as approved by the city of Owosso.

**SIGNATURE PAGE & LEGAL STATUS / ACKNOWLEDGE OF ADDENDUM(S)**

On behalf of \_\_\_\_\_, I hereby submit this proposal for **Owosso City Hall Improvements** for your consideration. The undersigned acknowledges that this proposal is subject to the General Conditions and the General Specifications included in the contract documents. In submitting this proposal, it is understood that the right is reserved by the CITY to reject any and all proposals, and waive any irregularities in the bidding process. The CITY may award this contract based on any combination of the total bid and/or alternates.

**Bid proposal by (Name of Firm):**

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**Please check the appropriate box and USE CORRECT LEGAL NAME.**

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Corporation                      State of Incorporation:

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Partnership                      List of names:

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DBA                                      State full name:

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Other                                      Explain:

---

**Signature of Bidder:**

---

**Title:**

---

**Signature of Bidder:**

---

**Title:**

---

**Address:**

---

**City, Zip:**

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**Telephone:**

---

**Email Address:**

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**Signed this                                      Day of                                      2024**

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**Bidder acknowledges receipt of the following Addenda:**

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**ADDENDUM NO: BIDDER'S INITIALS:**

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## GENERAL CONDITIONS

### 1. LOCAL PREFERENCE POLICY

The city of Owosso has a local preference policy for the purchase of goods and services. The policy in part states: *A business located within the city limits and paying real or personal property taxes to the city of Owosso will be granted a 6% bid advantage or \$2,500, whichever is less, over a business located outside Shiawassee County. A business located outside the city limits but within Shiawassee County and paying property taxes to the county will be granted a 3% bid advantage or \$2,500, whichever is less, over a business located outside Shiawassee County. The preference also applies to subcontractors performing 25% or more of the work of a general contract.*

### 2. BID ACCEPTANCE

The city reserves the right to reject any or all proposals. Unless otherwise specified, the city reserves the right to accept any item in the proposal. In case of error in extending the total amount of the bid, the unit prices shall govern. The city objects to any additional terms stated in any documents submitted by the contractor. Performance pursuant to our Purchase Order/Equipment Agreement constitutes a course of conduct consisting of Contractor's Agreement to the terms of our Purchase Order/Equipment Agreement.

### 3. PAYMENT

Unless otherwise stated by the bidder, time, concerning discount offered, will be computed from date of delivery and acceptance at destination or from date correct bill or claim voucher properly certified by the contractor is received. When so stated herein, partial payments, based on a certified approved estimate by the city of materials, supplies or equipment delivered or work done, may be made upon presentation of a properly-executed claim voucher. The final payment will be made by the city when materials, supplies, equipment or the work done have been fully delivered or completed to the full satisfaction of the city.

### 4. BID DEFAULT

In case of default by the bidder or contractor, the city of Owosso may procure the articles or services from other sources and hold the bidder or contractor responsible for any excess cost occasioned thereby.

### 5. UNIT PRICES

Prices should be stated in units of quantity specified.

### 6. QUOTED PRICES

Unless otherwise stated by the bidder, prices quoted will be considered as being based on delivery to a designated destination and to include all charges for packing, crating, containers, shipping, etc., and being in strict accordance with specifications and standards as shown.

### 7. SUBSTITUTIONS

Wherever a reference is made in the specifications or description of the materials, supplies, equipment, or services required, to a particular trade name, manufacturer's catalog, or model number, the bidder, if awarded a contract or order, will be required to furnish the particular item referred to in strict accordance with the specifications or description unless a departure or substitution is clearly noted and described in the proposal.

### 8. HOLD CITY HARMLESS

The bidder, if awarded an order or contract, agrees to protect, defend, and save the city harmless against any demand for payment for the use of any patented material, process, article, or device that may enter into the manufacture, construction, or form a part of the work covered by either order or contract. Bidder

further agrees to indemnify and save the city harmless from suits or action of every nature and description brought against it, for or on account of any injuries or damages received or sustained by any party or parties, by or from any of the acts of the contractor, his employees, subcontractors, or agents.

#### 9. COMPETITIVE BIDDING STATUTES

The laws of the state of Michigan, the charter and ordinances of the city of Owosso, as far as they apply to the laws of competitive bidding, contracts and purchases, are made a part hereof.

#### 10. SAMPLES

Samples, when requested, must be furnished free of expense to the city and, if not destroyed, will upon request be returned at the bidder's expense.

#### 11. BONDS

A certified check or bid bond is required, payable to the City of Owosso and equal to at least 5% of the total bid amount including all alternates. A 100% performance bond and labor and material bond shall be on file with the city before work commences.

#### 12. PROPOSAL GUARANTEE

All checks or bid bonds, except those of the three lowest bidders, will be returned when the bids have been opened and tabulated. The certified checks or bid bonds of the three lowest bidders will be held until the contract documents have been signed, after which remaining certified checks or bid bonds will be returned to the respective bidders.

#### 13. BIDDERS

The city may demand that the contractor file a sworn experience and financial statement setting forth the financial resources, adequacy of plant and equipment, organization, experience and other pertinent and material facts as may be desirable.

#### 14. INSURANCE AND HOLD HARMLESS

To the fullest extent permitted by law the Contractor agrees to defend, pay on behalf of, indemnify, and hold harmless the City of Owosso, its elected and appointed officials, employees, agents and volunteers, and others working on behalf of the City of Owosso against any and all claims, demands, suits, or loss, including all costs connected therewith, and for any damages which may be asserted, claimed, or recovered against or from the City of Owosso, by reason of personal injury, including bodily injury or death and/or property damage, including loss of use thereof, for all actions of the Contractor.

Contractor shall not commence work under this contract until they have obtained the insurance required under this paragraph, and shall keep such insurance in force during the entire life of this contract. All coverage shall be with insurance companies licensed and admitted to do business in the State of Michigan and acceptable to the City of Owosso. The requirements below should not be interpreted to limit the liability of Contractor. All deductibles and SIR's are the responsibility of Contractor. Contractor shall procure and maintain the following insurance coverage:

- a. Worker's Compensation Insurance including Employers' Liability Coverage, in accordance with all applicable statutes of the State of Michigan.
- b. Commercial General Liability Insurance on an "Occurrence Basis" with limits of liability not less than \$1,000,000 per occurrence and aggregate. Coverage shall include the following extensions: (A) Contractual Liability; (B) Products and Completed Operations; (C) Independent Contractors

Coverage; (D) Broad Form General Liability Extensions or equivalent, if not already included. (E) Explosion, Collapse, and Underground (XCU) coverage, if applicable. Limits may be obtained by the use of primary and excess/umbrella liability policies.

- c. Automobile Liability including Michigan No-Fault Coverages, with limits of liability not less than \$1,000,000 per occurrence, combined single limit for Bodily Injury, and Property Damage. Coverage shall include all owned vehicles, all non-owned vehicles, and all hired vehicles.
- d. Owners' and Contractor Protective Liability: The Contractor shall procure and maintain during the life of this contract, a separate Owners' and Contractor's Protective Liability Policy with limits of liability not less than \$1,000,000 per occurrence and aggregate for Personal Injury, Bodily Injury, and Property Damage. The City of Owosso shall be the "Named Insured" on said coverage.
- e. Additional Insured: Commercial General Liability and Automobile Liability as described above shall include an endorsement stating the City of Owosso shall be listed as additional insured. It is understood and agreed by naming the City of Owosso as additional insured, coverage afforded is considered to be primary and any other insurance the City of Owosso may have in effect shall be considered secondary and/or excess.
- f. Cancellation Notice: All policies, as described above, shall include an endorsement stating that it is understood and agreed Thirty (30) days, Ten (10) days for non-payment of premium, Advance Written Notice of Cancellation, shall be sent to: **(The City of Owosso, Terri Sinn, Bid Coordinator, 301 W. Main Street, Owosso, MI 48867).**
- g. Proof of Insurance Coverage: Contractor shall provide the City of Owosso at the time that the contracts are returned by him/her for execution, a Certificate of Insurance as well as the required endorsements. In lieu of required endorsements, if applicable, a copy of the policy sections where coverage is provided for additional insured and cancellation notice would be acceptable.

If any of the above coverages expire during the term of this contract, the Contractor shall deliver renewal certificates and endorsements to the City of Owosso at least ten (10) days prior to the expiration date.

#### 15. PROTECTION OF LAND MONUMENTS AND PROPERTY STAKES

Land monuments or stakes marking property corners shall not be moved or otherwise disturbed except as directed by the city. If any land monuments or lot stakes are moved or disturbed by the contractor, the cost of replacing each land monument or lot stake so moved or disturbed shall be deducted from any money due the contractor, as payment to the city for the cost of replacing said land monument or lot stakes.

#### 16. CONTRACTOR'S RESPONSIBILITY FOR WORK

The contractor shall be responsible for any damages that the work may sustain before its acceptance, and shall rebuild, repair, restore and make good, at its own expense, all injuries and damages to any portion of the work by the action of the elements or from any cause whatsoever before its acceptance. Neither the final payment nor any provision in the contract documents shall relieve the contractor of the responsibility for negligence or faulty materials or workmanship within the extent and period provided by law, and, upon written notice, the contractor shall remove any defects due therefrom and pay for any damaged due to other work resulting therefrom, which shall appear within one year after the date of completion and acceptance.

## 17. PAYMENT

At monthly intervals commencing after construction has been started, the city will make partial payment to the contractor based on a duly-certified estimate prepared by the city of the work done by the contractor during the preceding four-week period. Each estimate will be submitted to the city council for approval on either the first or third Monday of each month. The city will retain ten percent (10%) of the amount of each such estimate until final completion and acceptance of all work covered by this contract. Before the contractor shall demand final estimates or payment, contractor will furnish to the city, supported by sworn statements, satisfactory evidence that all persons that have supplied labor, materials, or equipment for the work embraced under this contract have been fully paid for the same; and that, in case such evidence be not furnished as aforesaid, such sums as the city may deem necessary to meet the lawful claims of such persons may be retained by the city from any monies that may be due or become due to the contractor under this contract until such liabilities shall be fully discharged and the evidence thereof be furnished to the city.

## 18. CITY'S RIGHT TO WITHHOLD CERTAIN AMOUNTS AND MAKE APPLICATION THEREOF

Besides the payment to be retained by the city under the preceding provisions of these general conditions, the city may withhold a sufficient amount of any payment otherwise due to the contractor to cover a) payments earned or due for just claims for furnish labor or materials on the project under this contract, b) for defective work not remedied and c) for failure of the contractor to make proper payments to subcontractors. The city shall disburse and shall have the right to act as agent for the contractor in disbursing such funds as have been previously withheld pursuant to this paragraph to the party or parties who are entitled to payment from it. The city will pay to the contractor a proper accounting of all such funds disbursed for the contractor.

## 19. OWNER'S RIGHT TO DO WORK

If the contractor should neglect to prosecute the work properly or fail to perform any provisions of this contract, the city, after three (3) days' written notice to the contractor and contractor's surety, may without prejudice to any other remedy he may have, make good such deficiencies and may deduct the cost of it from the payment due the contractor.

## 20. DEFINITION OF NOTICE

Where in any of the contract documents there is any provision in respect to the giving of notice, such notice shall be deemed given to the owner, when written notice is delivered to the city manager, or placed in the United States mail addressed to the city clerk; as to the contractor, when a written notice shall be delivered to contractor's representative at the project site or by mailing such written notice in the United States mail addressed to the contractor at the place stated in the bid proposal as the business address; as to the surety on the performance bond, when a written notice is placed in the United States mail addressed to the surety at the surety's home office or to its agent or agents who executed such performance bond on behalf of the surety.

## 21. SUBCONTRACTS

The contractor shall not subcontract any work in the execution of this contract without the written consent of the city. The contractor shall be responsible for the acts or omissions of any subcontractor and of anyone employed directly or indirectly by such subcontractor.

## 22. ASSIGNMENT OF CONTRACT

The contractor shall not assign this contract or any part hereof without the written consent of the city. No assignment shall be valid unless it shall contain a provision that any funds to be paid to the assignee under this agreement are subject to a prior lien for services rendered or materials or supplies for the performance

of the work specified in the contract in favor of all persons, firms, or corporations rendering such services or supplying such materials.

### 23. MAINTAINING TRAFFIC

The contractor shall provide flares, signs, barricades, traffic regulators, etc., to conform to the current *Michigan Manual of Uniform Traffic Control Devices* or as directed by the city. The contractor shall not close any road or street without the permission of the city. If any street or road is to be closed by the contractor, it shall be the responsibility of the contractor to notify the Owosso fire department when the street will be closed and again when the street is open to traffic. Traffic control devices for any detours deemed necessary by the city shall be provided by the contractor. Cost of maintaining shall be incidental to the cost of the project unless otherwise provided.

### 24. ORDER OF COMPLETION

The contractor shall submit, whenever requested by the city, a schedule of the work showing completion dates. The city may request that certain portions of the work be done before other portions. If so requested, the contractor shall arrange to schedule to meet the request by the owner.

### 25. USE OF COMPLETED PORTIONS

The city shall have the right to take possession and use any completed or partially completed portions of the work; but such taking possession and use shall not be deemed acceptance. Pending final completion and acceptance of the work, all necessary repairs and adjustments on any section of the work due to defective material, workmanship, natural causes, or other operations of the contractor, other than normal wear and tear, shall be done by and at the expense of the contractor.

### 26. WATER SUPPLY

The contractor shall secure an adequate water supply for use in construction and for drinking water for his employees. If the city's water is used on the work, the contractor shall make the necessary application and shall pay all costs involved. Connections, piping and fittings for conveying water shall be furnished and maintained by the contractor. Contractor shall pay for water according to the city's established rates.

### 27. CLEANUP

The contractor shall keep the project free from waste materials or rubbish caused by its employees or work. This includes as a minimum excess excavation or backfill material, broken or rejected materials, empty containers or general debris. The owner may require complete cleanup of certain areas as construction is completed.

### 28. SUPERVISION

The contractor shall have a superintendent on the job site to coordinate and expedite the various construction activities for the duration of this contract.

### 29. EQUAL EMPLOYMENT OPPORTUNITY AND OTHER CLAUSES

The contractor shall agree not to discriminate against any employee or applicant for employment because of age, race, religion, color, handicap, sex, physical condition, developmental disability as defined by Michigan Compiled Statutes, or national origin. This provision shall include but not be limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rate of pay or other forms of compensation, and selection for training including apprenticeship. The contractor further agrees to take affirmative action to ensure equal employment opportunities for persons with disabilities. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provision of the non-discrimination clause.



## LOCAL PREFERENCE POLICY

The following affidavit should be completed if a bidder is located within Shiawassee County or intends to sub-contract more than twenty-five percent (25%) to a Shiawassee County based business: The city of Owosso has a local preference policy for the purchase of goods and services as recorded in the city ordinance in section 2-348. "Lowest qualified bidder" defined.

1. The term "lowest qualified bidder," as used in this division, shall mean the lowest bidder having qualifications to perform the work which are satisfactory to the council. The lowest bidder shall be determined based on an adjusted bid tabulation which shall be prepared in the following manner: To the bid of any bidder which is neither a city-based business nor a county-based business shall be added an amount equal to six (6) percent of the bid or two thousand five hundred dollars (\$2,500.00), whichever is less.
2. To the bid of any bidder which is a county-based business shall be added an amount equal to three (3) percent of the bid or two thousand five hundred dollars (\$2,500.00), whichever is less; provided, however, that if no bid is received from a city-based business, no additional amount shall be added to the bid of a county-based business.
3. "Owosso-based business" shall be interpreted to mean a business registered with the county clerk or a corporation registered with the state having a business address within the city limits which pays real and/or personal property taxes levied by the city.

The term "county-based business" shall be interpreted to mean a business other than a city-based business registered with the county clerk or a corporation registered with the state having a business address within the county which pays real and/or personal property taxes levied by the county.

4. If twenty-five (25) percent or more of a contract for construction or other services is to be subcontracted by a city-based business bidder to a non-city-based business or businesses, or by a county-based business bidder to a non-county-based business or businesses, the adjusted bid shall be calculated by applying the provisions of this section separately to each portion of the contract based on the status of the contractor or subcontractor performing that portion of the contract as a city-based or county-based business.

**LOCAL PREFERENCE AFFIDAVIT**

In accordance with Section 2-348 of the Owosso city code, the bid from a business located in Shiawassee County shall be adjusted to reflect a preference. In order for the city to calculate the adjustment, the bidder hereby deposes and states that their business address is registered, and is currently paying real and/or personal property taxes in Shiawassee County at the following address:

\_\_\_\_\_

Registered business address

The affiant further deposes and states that a sub-contract with a business registered, and paying real and/or personal property taxes in Shiawassee County will be executed for a percentage equal to or greater than twenty-five percent (25%) as stated below:

\_\_\_\_\_

Business name and address of sub-contractor

\_\_\_\_\_

Percentage of contract

\_\_\_\_\_

Authorized signature

\_\_\_\_\_

Date

\_\_\_\_\_

Title

\_\_\_\_\_

Company name

## W-9 INFORMATION FOR LEGAL STATUS

**Sole proprietor.** Enter your individual name as shown on your income tax return on the "Name" line. You may enter your business, trade, or "doing business as (DBA)" name on the "Business name/disregarded entity name" line.

**Partnership, C Corporation, or S Corporation.** Enter the entity's name on the "Name" line and any business, trade, or "doing business as (DBA) name" on the "Business name/disregarded entity name" line.

**Disregarded entity.** Enter the owner's name on the "Name" line. The name of the entity entered on the "Name" line should never be a disregarded entity. The name on the "Name" line must be the name shown on the income tax return on which the income will be reported. For example, if a foreign LLC that is treated as a disregarded entity for U.S. federal tax purposes has a domestic owner, the domestic owner's name is required to be provided on the "Name" line. If the direct owner of the entity is also a disregarded entity, enter the first owner that is not disregarded for federal tax purposes. Enter the disregarded entity's name on the "Business name/disregarded entity name" line. If the owner of the disregarded entity is a foreign person, you must complete an appropriate Form W-8.

**Note.** Check the appropriate box for the federal tax classification of the person whose name is entered on the "Name" line (Individual/sole proprietor, Partnership, C Corporation, S Corporation, Trust/estate).

**Limited Liability Company (LLC).** If the person identified on the "Name" line is an LLC, check the "Limited liability company" box only and enter the appropriate code for the tax classification in the space provided. If you are an LLC that is treated as a partnership for federal tax purposes, enter "P" for partnership. If you are an LLC that has filed a Form 8832 or a Form 2553 to be taxed as a corporation, enter "C" for C corporation or "S" for S corporation. If you are an LLC that is disregarded as an entity separate from its owner under Regulation section 301.7701-3 (except for employment and excise tax), do not check the LLC box unless the owner of the LLC (required to be identified on the "Name" line) is another LLC that is not disregarded for federal tax purposes. If the LLC is disregarded as an entity separate from its owner, enter the appropriate tax classification of the owner identified on the "Name" line.

**Other entities.** Enter your business name as shown on required federal tax documents on the "Name" line. This name should match the name shown on the charter or other legal document creating the entity. You may enter any business, trade, or DBA name on the "Business name/disregarded entity name" line.

Please see attached W-9 Request for Taxpayer Identification Number and Certification form for a detailed explanation on filling out the W-9 form.

# Request for Taxpayer Identification Number and Certification

**Give Form to the  
 requester. Do not  
 send to the IRS.**

▶ Go to [www.irs.gov/FormW9](http://www.irs.gov/FormW9) for instructions and the latest information.

Print or type. See Specific Instructions on page 3.	<p><b>1</b> Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.</p> <hr/> <p><b>2</b> Business name/disregarded entity name, if different from above</p> <hr/> <p><b>3</b> Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only <b>one</b> of the following seven boxes.</p> <p><input type="checkbox"/> Individual/sole proprietor or single-member LLC                  <input type="checkbox"/> C Corporation                  <input type="checkbox"/> S Corporation                  <input type="checkbox"/> Partnership                  <input type="checkbox"/> Trust/estate</p> <p><input type="checkbox"/> Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ▶ _____</p> <p><b>Note:</b> Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is <b>not</b> disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner.</p> <p><input type="checkbox"/> Other (see instructions) ▶ _____</p>	<p><b>4</b> Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):</p> <p>Exempt payee code (if any) _____</p> <p>Exemption from FATCA reporting code (if any) _____</p> <p style="font-size: small;">(Applies to accounts maintained outside the U.S.)</p>
	<p><b>5</b> Address (number, street, and apt. or suite no.) See instructions.</p> <hr/> <p><b>6</b> City, state, and ZIP code</p> <hr/> <p><b>7</b> List account number(s) here (optional)</p>	<p>Requester's name and address (optional)</p> <hr/>

## Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

**Note:** If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

<b>Social security number</b>											
				-			-				
<b>or</b>											
<b>Employer identification number</b>											
				-							

## Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

**Certification instructions.** You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

<b>Sign Here</b>	Signature of U.S. person ▶	Date ▶
------------------	----------------------------	--------

## General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

**Future developments.** For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to [www.irs.gov/FormW9](http://www.irs.gov/FormW9).

### Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)

- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

*If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See What is backup withholding, later.*

**NOTICE OF AWARD**

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

TO: \_\_\_\_\_  
(BIDDER)

ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

PROJECT: Owosso City Hall Improvements

OWNER's CONTRACT NO.: \_\_\_\_\_

CONTRACT FOR: Owosso City Hall Improvements  
(Insert name of Contract as it appears in the Bidding Documents)

You are notified that your Bid dated \_\_\_\_\_ for the above Contract has been considered. You are the apparent Successful Bidder and have been awarded a contract for \_\_\_\_\_  
\_\_\_\_\_

(Insert total Work, amendments, alternates or sections or Work awarded)

The Contract Price of your contract is \_\_\_\_\_  
(\$ \_\_\_\_\_).

1 copy of each of the proposed Contract Documents (except Drawings & Technical Specifications) accompany this Notice of Award.

The drawings and specifications have been provided to you during the bidding process. These are now the contract documents including all amendments and alternates to date.

You must comply with the following conditions precedent within ten days of the date of this Notice of Award, that is by:

- 1. You must deliver to Owner the fully executed counterparts of the Agreement including the Construction Performance Bond, and the Certificates of Insurance.

Failure to comply with these conditions within the time specified will entitle OWNER to consider your bid in default, to annul this Notice of Award and to declare your Bid Security forfeited.

Within ten days after you comply with the above conditions, OWNER will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

City of Owosso  
\_\_\_\_\_  
(OWNER)

By: \_\_\_\_\_  
(AMY KIRKLAND, CITY CLERK)

By: \_\_\_\_\_  
(ROBERT TEICH, MAYOR)

ACCEPTANCE OF AWARD

By: \_\_\_\_\_  
(CONTRACTOR)

\_\_\_\_\_  
(AUTHORIZED SIGNEE NAME)

Copy to PROFESSIONAL

\_\_\_\_\_  
(AUTHORIZED SIGNEE TITLE)

\_\_\_\_\_  
(DATE)

Attachment "A"

FAMILIAL DISCLOSURE STATEMENT

AFFIDAVIT OF \_\_\_\_\_  
(insert name of affiant)

STATE OF MICHIGAN                    )  
  )ss  
COUNTY OF \_\_\_\_\_            )

\_\_\_\_\_ makes this Affidavit under oath and states as follows:  
(insert name of affiant)

1. I am a/the:

- President
- Vice-President
- Chief Executive Officer
- Member
- Partner
- Owner
- Other (please specify) \_\_\_\_\_

of [insert name of firm], a bidder for construction/contractor services for **City of Owosso, Michigan.**

2. I have personal knowledge and/or I have personally verified that the following are all of the familial relationships existing between the owner(s) and the employee(s) of the aforementioned contractor and the school district's superintendent and/or board members:

\_\_\_\_\_  
\_\_\_\_\_

3. I have authority to bind the aforementioned firm with the representations contained herein, and I am fully aware that the school district will rely on my representations in evaluating bids for engineering services.

4. I declare the above information to be true to the best of my knowledge, information and belief. I could completely and accurately testify regarding the information contained in this affidavit if requested to do so.

\_\_\_\_\_  
(signature of affiant)

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

Subscribed and sworn before me in \_\_\_\_\_ County,  
Michigan, on the \_\_\_ day of \_\_\_\_\_, 2022

\_\_\_\_\_  
(signature)  
\_\_\_\_\_  
(printed)  
Notary public, State of Michigan, County of \_\_\_\_\_  
My Commission expires on \_\_\_\_\_  
Acting in the County of \_\_\_\_\_



Attachment "B"

IRAN ECONOMIC SANCTIONS ACT CERTIFICATION

I am the \_\_\_\_\_ [title] of \_\_\_\_\_ [bidder], or I am bidding in my individual capacity ("Bidder"), with authority to submit a binding bid for the provision of contractor services to **City of Owosso, Michigan**. I have personal knowledge of the matters described in this Certification, and I am familiar with the Iran Economic Sanctions Act, MCL 129.311, et seq. ("Act"). I am fully aware that the school district will rely on my representations in evaluating bids.

I certify that Bidder is not an Iran-linked business, as that term is defined in the Act. I understand that submission of a false certification may result in contract termination, ineligibility to bid for three (3) years, and a civil penalty of \$250,000 or twice the bid amount, whichever is greater, plus related investigation and legal costs.

\_\_\_\_\_  
(signature)

\_\_\_\_\_  
(printed)

\_\_\_\_\_  
(date)

## SECTION 01 10 00

### SUMMARY

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Contract description.
  - 2. Contractor's use of Site
  - 3. Work sequence.
  - 4. Owner occupancy.
  - 5. Permits.
  - 6. Specification conventions.

##### 1.2 CONTRACT DESCRIPTION

- A. The Contractor shall furnish all the labor, material and construction equipment and perform all the work for this project as shown on the Drawings and described in the specifications prepared by Spicer Group, Inc. Contractor shall be responsible for the entire work until completed and accepted by the Owner.

##### 1.3 CONTRACTOR'S USE OF SITE

- A. Limit use of Site to allow:
  - 1. Owner occupancy.
  - 2. Use of site by Public.

##### 1.4 WORK SEQUENCE

- A. Construct Work in a positive direction during the construction period, coordinate construction schedule and operations with Owner and Owner's Representative.

##### 1.5 OWNER OCCUPANCY

- A. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

##### 1.6 PERMITS

- A. Furnish necessary permits for construction of Work.

##### 1.7 SPECIFICATION CONVENTIONS

- A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

END OF SECTION

## SECTION 01 20 00

### PRICE AND PAYMENT PROCEDURES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Application for Payment.
- B. Change procedures.
- C. Defect assessment.
- D. Unit prices.

##### 1.2 APPLICATION FOR PAYMENT

- A. Contractor will prepare progress payments in accordance with the Payment Schedule shown in the Agreement. Progress payments shall be submitted in AIA Document G702 and G703.
- B. Format will follow the itemized bid in the Proposal.
- C. Contractor shall submit waivers for each progress payment in accordance with the General Conditions.
- D. Payment will be subject to retainage as set forth in Public Act No. 524.

##### 1.3 CHANGE PROCEDURES

- A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Engineer of any error, inconsistency, omission, or apparent discrepancy.
- C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.
- D. Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing a field order.
- E. Engineer may issue a Bulletin or Notice of Changer including a detailed description of proposed change with supplementary or revised Drawings and Specifications. Contractor will prepare and submit estimate within (2) two days.
- F. Contractor may propose changes by submitting a request for change to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the

change and the effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on the Work.

- G. Stipulated Sum/Price Change Order: Based on Bulletin or Notice of Change and Contractor's price quotation and Contractor's request for Change Order as approved by Engineer.
- H. Unit Price Change Order: For Contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of that which are not predetermined, execute Work under Work Directive Change. Changes in Contract Sum/Price or Contract Time will be computed as specified for Time and Material Change Order.
- I. Work Directive Change: Engineer may issue directive, signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- J. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- K. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.
- L. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.
- M. Change Order Forms: Architects/Engineer's Form.
- N. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

#### 1.4 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.
- C. Authority of Engineer and Owner to assess defects and identify payment adjustments is final.
- D. Nonpayment for Rejected Products: Payment will not be made for rejected products.

#### 1.5 UNIT PRICES

- A. Authority: Measurement methods are delineated in individual Specification Sections.
- B. Measurement methods delineated in individual Specification Sections complement criteria of this Section. In event of conflict, requirements of individual Specification Section govern.
- C. Engineer will take measurements and compute quantities accordingly. Provide assistance in taking of measurements.

- D. Unit Quantities: Quantities and measurements indicated on Bid Form are for Contract purposes only. Actual quantities provided shall determine payment.
- E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.
- F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
- G. Measurement of Quantities:
  - 1. Weigh Scales: Inspected, tested, and certified by applicable State weights and measures department within past year.
  - 2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
  - 3. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
  - 4. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.
  - 5. Measurement by Area: Measured by square dimension using mean length and width or radius.
  - 6. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
  - 7. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

#### 1.6 PREVAILING WAGE REQUIREMENTS

- A. This project does NOT require prevailing wages.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 25 00

### SUBSTITUTION PROCEDURES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Quality assurance.
- B. Product options.
- C. Product substitution procedures.

##### 1.2 QUALITY ASSURANCE

- A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.
- B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.
- C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Owner.

##### 1.3 PRODUCT OPTIONS

- A. See Section 01 60 00 - Product Requirements.

##### 1.4 PRODUCT SUBSTITUTION PROCEDURES

- A. Engineer will consider requests for substitutions only within **15** days after date of Owner-Contractor Agreement.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
  - 1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
  - 2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
  - 3. Reference to Article and Paragraph numbers in Specification Section.
  - 4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
  - 5. Changes required in other Work.
  - 6. Availability of maintenance service and source of replacement parts as applicable.
  - 7. Certified test data to show compliance with performance characteristics specified.
  - 8. Samples when applicable or requested.
  - 9. Other information as necessary to assist Engineer's evaluation.

- D. A request constitutes a representation that Contractor:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
  2. Will provide same warranty for substitution as for specified product.
  3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
  4. Waives claims for additional costs or time extension that may subsequently become apparent.
  5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
  6. Will reimburse Owner for review or redesign services associated with reapproval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals without separate written request or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
1. Submit requests for substitutions.
  2. Submit three copies of Request for Substitution for consideration. Limit each request to one proposed substitution.
  3. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
  4. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 30 00

### ADMINISTRATIVE REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Field Engineering
- C. Cutting and Patching
- D. Preconstruction meeting.
- E. Progress meetings.
- F. Closeout meeting.
- G. Alteration procedures.

##### 1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Owner Contract Agreement to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
- C. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- D. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
- E. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

##### 1.3 CUTTING AND PATCHING

- A. Coordinate with Engineer 48 hours prior to cutting and patching.
- B. Employ skilled and experienced installer to perform cutting and patching.
- C. Submit written request in advance of cutting or altering elements which affects:
  - 1. Structural integrity of element.
  - 2. Integrity of weather-exposed or moisture-resistant elements.
  - 3. Efficiency, maintenance, or safety of element.



4. Visual quantities of sight-exposed elements.
  5. Work of Owner or separate contractor.
- D. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
    1. Fit the several parts together, to integrate with other Work.
    2. Uncover Work to install or correct ill-timed Work.
    3. Remove and replace defective and non-conforming Work.
    4. Remove samples of installed Work for testing.
  - E. Execute work by methods which will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.
  - F. Cut rigid materials using masonry saw or core drill.
  - G. Restore Work with new products in accordance with requirements of Contract Documents.
  - H. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
  - I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
  - J. Identify any hazardous substance or condition exposed during the Work to the Engineer for decision or remedy.

#### 1.4 PRECONSTRUCTION MEETING

- A. Owners Representative will schedule and preside over meeting after Notice of Award.
- B. Attendance Required: Owner's Representative, Owner, appropriate governmental agency representatives, applicable public and private utility companies and Contractor, subcontractors to be utilized on the project.

#### 1.5 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work. Meetings shall be bi-weekly and shall include a virtual and in-person options. Coordinate with Owner's Representative.
- B. Contractor will make arrangements for meetings. Contractor shall coordinate the agenda with Owner's Representative and provide copies for participants and preside over meetings.
- C. Attendance Required: Job superintendent, major Subcontractors, Contractors and suppliers, and Owner's Representative, Owner, as appropriate to agenda topics for each meeting.

#### PART 2 PRODUCTS - Not Used

#### PART 3 EXECUTION

##### 1.6 PROCEDURES

- A. The facility will be OPEN during construction. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage.

1. Perform Work not to interfere with operations of occupied areas.
  2. Keep utility and service outages to a minimum and perform only after written approval of Owner.
  3. Clean Owner-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.
  4. Temporary secured fencing by Contractor is required.
- B. Materials: As specified in product Sections.
- C. Employ skilled and experienced installer to perform alteration and renovation Work.
- D. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion. Comply with Section 01 70 00 - Execution and Closeout Requirements
- E. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- F. Remove debris and abandoned items from area and from concealed spaces.
- G. Prepare surface and remove surface finishes to permit installation of new Work and finishes.
- H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.
- I. Remove, cut, and patch Work to minimize damage and to permit restoring products and finishes to original or specified condition.
- J. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified or new condition for each material, with neat transition to adjacent finishes.
- K. Where new Work abuts or aligns with existing Work, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- L. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Engineer for review.
- M. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition to Engineer for review.
- N. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- O. Finish surfaces as specified in individual product Sections.

END OF SECTION

## SECTION 01 33 00

### SUBMITTAL PROCEDURES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Definitions.
- B. Submittal procedures.
- C. Construction progress schedules.
- D. Proposed product list.
- E. Product data.
- F. Shop Drawings.
- G. Samples.
- H. Other submittals.
- I. Test reports.
- J. Certificates.
- K. Manufacturer's instructions.
- L. Manufacturer's field reports.
- M. Erection Drawings.
- N. Contractor review.
- O. Engineer review.

##### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.
- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

##### 1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer-accepted form.

- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project, and deliver to Engineer. Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- H. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- I. Allow space on submittals for Contractor and Engineer review stamps.
- J. When revised for resubmission, identify changes made since previous submission.
- K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

#### 1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial progress schedule in duplicate within 15 days after date established in Notice to Proceed for Engineer and Owner review.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Submit horizontal bar chart with separate line for each major section of Work or operation, identifying first workday of each week.
- E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- F. Indicate estimated percentage of completion for each item of Work at each submission.
- G. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and under Allowances.

## 1.5 PROPOSED PRODUCT LIST

- A. Within 5 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

## 1.6 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Submit number of copies Contractor requires, plus three copies Engineer will retain.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

## 1.7 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
  - 1. Include signed and sealed calculations to support design.
  - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
  - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit number of opaque reproductions Contractor requires, plus two copies Engineer will retain.
- E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

## 1.8 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
  - 1. Submit to Engineer for aesthetic, color, and finish selection.
  - 2. Submit Samples of finishes, textures, and patterns for Engineer selection.

- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in Specification Section.
- H. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

#### 1.9 OTHER SUBMITTALS

- A. Closeout Submittals: Comply with Section 01 70 00 - Execution and Closeout Requirements.
- B. Informational Submittal: Submit data for Engineer's knowledge for Owner.
- C. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

#### 1.10 TEST REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

#### 1.11 CERTIFICATES

- A. Informational Submittal: Submit certification when specified in individual specification sections from manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

#### 1.12 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.

- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

#### 1.13 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge for Owner.
- B. Submit report in duplicate within 5 days of observation to Engineer for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.
- D. Identify conflicts between manufacturer's instructions and Contract Documents.

#### 1.14 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Engineer's knowledge for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

#### 1.15 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.
- B. Contractor: Responsible for:
  - 1. Determination and verification of materials including manufacturer's catalog numbers.
  - 2. Determination and verification of field measurements and field construction criteria.
  - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
  - 4. Determination of accuracy and completeness of dimensions and quantities.
  - 5. Confirmation and coordination of dimensions and field conditions at Site.
  - 6. Construction means, techniques, sequences, and procedures.
  - 7. Safety precautions.
  - 8. Coordination and performance of Work of all trades.
- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

#### 1.16 ENGINEER REVIEW

- A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to

perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Owner and Contractor.

- B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION



## SECTION 01 40 00

### QUALITY REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Field Samples.
- E. Labeling.
- F. Testing and inspection services.
- G. Bench marks and control elevations.
- H. Manufacturers' field services.

##### 1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, requires clarification from Engineer before proceeding.
- D. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work using persons qualified to produce required and specified quality.
- F. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- G. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.
- H. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

### 1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

### 1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

### 1.5 FIELD SAMPLES

- A. Acceptable samples represent a quality level for the Work.

### 1.6 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
  - 1. Model number.
  - 2. Serial number.
  - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

### 1.7 TESTING AND INSPECTION SERVICES

- A. Contractor will employ and pay for services to perform materials inspection and testing including compaction.

- B. Reports will be submitted to Engineer, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- C. Retesting required because of non-conformance to specified requirements shall be performed by the same agency. Payment for retesting will be charged to the Contractor.

#### 1.8 BENCHMARKS AND CONTROL ELEVATIONS

- A. Elevations for proposed work shall be from bench marks established for this project.
- B. Verify elevations of existing features against project benchmarks.
- C. Notify Engineer of conflicts in elevations, which affect the proposed work.

#### 1.9 MANUFACTURER'S FIELD SERVICES

- A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment commissioning and as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer.
- C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.
- D. Refer to Section 01 33 00 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 50 00

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Temporary Gas and Electricity:
  - 1. May not be required if contractor can maintain operations for the City.
  - 2. Electrical shutdown serving the server room and critical infrastructure shall be limited to weekend or after-hours. The new transfer switch installation would require a shutdown of the 3 phase service which may not affect critical infrastructure. Other electrical shutdowns could be scheduled for after generator is installed to minimize shutdown time.
  - 3. Gas shutdown is not anticipated if excavation work and roof top replacements can occur prior to heating season. Otherwise, temporary gas or propane heat is required.
- B. Construction Facilities:
  - 1. Parking.
  - 2. Progress cleaning and waste removal.
  - 3. Fire-prevention facilities.
- C. Temporary Controls:
  - 1. Barriers.
  - 2. Water control.
  - 3. Dust control.
  - 4. Erosion and sediment control.
  - 5. Noise control.
  - 6. Pest and rodent control.
  - 7. Pollution control.
- D. Removal of utilities, facilities, and controls.
- E. Protection of Installed Work.
- F. Protection of Existing.
- G. Progress Cleaning.

##### 1.2 TEMPORARY GAS & ELECTRICITY

- A. The Contractor shall pay all service fees associated with the setting up and modifications of natural gas and electrical service fees. Note, Consumers has been notified of the scope of work including temporary removal of the gas meter and re-installation after excavation is complete.
- B. The Contractor shall provide temporary, tented, heat as required for winter construction as required to meet the substantial completion date(s). NOTE – work is expected to be completed prior to heating season 2025.

- C. Complement existing power service capacity and characteristics as required for construction operations.
- D. Provide power outlets with branch wiring and distribution boxes located as required for construction operations. Provide suitable, flexible power cords as required for portable construction tools and equipment.
- E. Provide main service disconnect and overcurrent protection at convenient location switch at source distribution equipment meter.
- F. Permanent convenience receptacles may be used during construction.

### 1.3 PARKING

- A. Maintenance:
  1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice, and the like.
  2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.
- B. Removal, Repair:
  1. Remove temporary materials and construction at Substantial Completion.
  2. Remove underground Work and compacted materials to depth of 2 feet fill and grade Site as indicated.
  3. Repair existing and permanent facilities damaged by use, to original condition.
- C. Mud from Site vehicles: Provide means of removing mud from vehicle wheels before entering streets.

### 1.4 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, before enclosing spaces.
- C. Broom and vacuum clean interior areas before starting surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from Site and dispose of off-Site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

### 1.5 FIRE-PREVENTION FACILITIES

- A. Prohibit smoking within buildings under construction and demolition. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.

- B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Standpipes: Maintain existing standpipes in usable condition to height within one floor of floor being demolished.
- D. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
  - 1. Provide one fire extinguisher at each stairway on each floor of buildings under construction and demolition.
  - 2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.
  - 3. Provide minimum of one fire extinguisher on roof during roofing operations using heat-producing equipment.

## 1.6 BARRIERS

- A. Provide secure, lockable, barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing building.
  - 1. Barricade Construction: As indicated on Drawings.
  - 2. Covered Walkway Construction: As indicated on Drawings.
- C. Tree and Plant Protection: Preserve and protect existing trees and plants designated to remain.
  - 1. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
  - 2. Provide 6 foot-high barriers around drip line, with access for maintenance.
  - 3. Replace trees and plants damaged by construction operations.
- D. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.
- E. Provide access to all adjacent buildings for use during construction.

## 1.7 WATER CONTROL

- A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.
- B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.
- C. Trenches shall be dewatered to provide a stable base for structures and piping.
- D. Contractor shall arrange temporary water service for construction with the City of Dearborn Dept. of Public Works.

## 1.8 DUST CONTROL

- A. Execute Work by methods that minimize raising dust from construction operations.

- B. Provide positive means to prevent airborne dust from dispersing into atmosphere and into Owner-occupied areas.

#### 1.9 EROSION AND SEDIMENT CONTROL

- A. Conform to Part 91 of Public Act 451 of 1994, relative to Soil Erosion and Sedimentation Control for the life of the project.
- B. Minimize amount of bare soil exposed at one time.
- C. Provide temporary measures such as berms, dikes, and drains to prevent sediment from entering adjacent waterways.
- D. Do not deposit trash, debris, or sediment in tile or open drains.
- E. Immediately repair trenches located within the traveled surface of roadways.
- F. Landscape construction areas as soon as practical after work is complete according to Sections 32 91 19 – Landscape Grading, 32 92 19 – Seeding.

#### 1.10 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

#### 1.11 PEST AND RODENT CONTROL

- A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work and entering facility.
- B. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

#### 1.12 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.
- B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

#### 1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials before Substantial Completion inspection.
- B. Remove underground installations to minimum depth of 4 feet. Grade Site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary Work.

- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.
- E. A sufficient sum of money to remove and replace or repair any utilities damaged or relocated during the construction of the project shall be included in total contract amount.

#### 1.14 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual specification Sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Prohibit traffic from landscaped areas.

#### 1.15 PROTECTION OF EXISTING

- A. CALL “MISS DIG” 811 or (1-800-482-7171) A MINIMUM OF THREE WORKING DAYS PRIOR TO CONSTRUCTION.
- B. Obtain a copy of Positive Response. Contact Miss Dig for additional assistance if there are any utilities not marked or cleared through the Positive Response System.
- C. Contact Miss Dig for additional assistance if there is a discrepancy in the field from the Positive Response System.
- D. Contact Miss Dig for additional assistance if utility is not found within the applicable “approximate locations” marked in the field.
- E. Protect landscaped areas. Damaged areas shall be replaced in kind.
- F. Protect utilities encountered during the work. Replace or repair damaged utilities.
- G. Protect drives, roadways, and sidewalks. Repair as required in following sections.
- H. Protect mailboxes. Relocate temporarily until mailboxes can be returned to original location. All mail boxes and posts must be returned to their original condition or better at no additional cost to the project.
- I. Protect trees, shrubs, and bushes:
  - 1. Where trees, shrubs, and bushes are too large to be replaced in kind, the proposed utility shall be installed in a boring or tunneling operation unless written consent is given by the property owner for removal. Owner and Engineer shall each be given one copy of consent letters.
  - 2. Where requested by the Property Owner, timber from removed trees shall be cut into 6 foot lengths and stockpiled along the work or as specified in the consent letter.
  - 3. Proper disposal of removed trees or sections of removed trees not wanted by the property owner shall become the responsibility of the Contractor.
  - 4. Trees, shrubs, and bushes that are removed and replaced shall be transplanted by an established nursery.



- J. Utilities must remain in service. If it becomes necessary to interrupt a utility service, the utility authority must be notified immediately and steps taken to restore temporary or permanent service as soon as possible.
- K. Maintain outlets for drains. Provide temporary pumping if necessary.
- L. Expose utility mains and services by hand in the trench.
- M. Where utility and drainage piping crosses the trench, support the piping according to the utility authority's standards and backfill to the top with compacted sand.

#### 1.16 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Clean road surface daily to the Owner's and/or Engineer's satisfaction.
- C. Complete leveling, remove excess material and debris and restore drainage not more than 1000 feet behind construction.
- D. A sufficient sum of money to remove and replace or repair any utilities damaged or relocated during the construction of the project shall be included in total contract amount.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 60 00

### PRODUCT REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.

##### 1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Domestic Products: Except where specified otherwise, domestic products are required and interpreted to mean products mined, manufactured, fabricated, or produced in United States or its territories.
- E. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.
- F. Furnish interchangeable components from same manufacturer for components being replaced.

##### 1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products according to manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

##### 1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Contractor shall provide secured, insured, on-site storage and/or secured and insured off-site storage.

- B. Provide off-Site storage and protection when Site does not permit on-Site storage or protection
- C. Store and protect products according to manufacturer's instructions.
- D. Store products with seals and labels intact and legible.
- E. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- F. For exterior storage of fabricated products, place products on sloped supports above ground.
- G. In first Paragraph below bonded storage may be required to permit progress payments to Contractor.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- J. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

#### 1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 01 25 00 - Substitution Procedures.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 70 00

### EXECUTION AND CLOSEOUT REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Field engineering.
- B. Closeout procedures.
- C. Project record documents.
- D. Maintenance service
- E. Warranties
- F. Progress Payments.
- G. Examination.
- H. Preparation.
- I. Execution.
- J. Cutting and patching.
- K. Protecting installed construction.
- L. Final cleaning.

##### 1.2 FIELD ENGINEERING

- A. Prior to beginning Work, verify and establish floor elevations of existing facilities to ensure that new Work will meet existing elevations in smooth and level alignment except where specifically detailed or indicated otherwise.

##### 1.3 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed. Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.
- B. Provide submittals to Engineer that are required by governing or other authorities.
- C. Provide Consent of Surety and all Final Waivers.

##### 1.4 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.

- B. Remove sediment from storm sewers, and catch basins.
- C. Clean site; sweep paved areas, rake clean landscaped surfaces.
- D. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- E. Landscape areas as required in documents.
- F. Restore roads, driveways, parking areas, lawns, drainage, and other items disturbed during construction to original condition or as required by the documents.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed Shop Drawings, product data, and Samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Store record documents separate from documents used for construction.
- C. Record information concurrent with construction progress.
- D. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates used.
  - 3. Changes made by Addenda and modifications.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
  - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
  - 2. Include locations of concealed elements of the Work.
  - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
  - 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
  - 5. Identify and locate existing buried or concealed items encountered during Project.
  - 6. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 7. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 8. Field changes of dimension and detail.
  - 9. Details not on original Drawings.
- F. Contractor shall provide as-built drawings for all underground and under-slab pool piping, splash pad piping, sanitary, and water piping. As-builts shall be clearly marked on a clean set of plans,

with dimensions and depth of piping. Submit marked-up paper copy documents to Engineer before Substantial Completion.

#### 1.6 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in Specification Sections for 1 year from date of Substantial Completion.
- B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

#### 1.7 WARRANTIES

- A. Execute and assemble documents from Sub-contractors, suppliers, and manufacturers.
- B. Provide Table of Contents and assemble in three D size ring three ring binder with durable plastic cloth cover.
- C. Submit prior to final Application for Payment.
- D. Warranty all work for a period of one year from the date of the final progress payment.

#### 1.8 PROGRESS PAYMENTS

- A. The Owner may request from the Contractor waivers for proof of payment to all sub-contractors and suppliers utilized on this project prior to issuing payments.
- B. The Owner may request from the Contractor a Sworn Statement listing all sub-contractors and suppliers, their involvement with the project, their subcontracted amount, amount paid to date, and balance due prior to issuing payment.
- C. Failure to provide this information may result in not receiving payments or payments not being issued in a timely manner.

#### 1.9 CORRECTION PERIOD

- A. For the period of one year from the date of final payment, promptly correct work or replace materials that are found to be defective.

## PART 2 PRODUCTS - Not Used

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available with correct characteristics and in correct locations.

### 3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

### 3.3 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.
- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
  - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
  - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
  - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.
- E. Allow for expansion of materials and building movement.
- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.

1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
  2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
1. Refer questionable mounting heights choices to Engineer for final decision.
  2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

### 3.4 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

END OF SECTION



## SECTION 03 10 00

### CONCRETE FORMING AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Formwork for cast-in-place concrete.
  - 2. Shoring, bracing, and anchorage.
  - 3. Form accessories.
  - 4. Form stripping.
- B. Related Requirements:
  - 1. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel and required supports for cast-in-place concrete.
  - 2. Section 03 30 00 - Cast-in-Place Concrete.

##### 1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 - Specifications for Structural Concrete.
  - 3. ACI 318 - Building Code Requirements for Structural Concrete.
  - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest & Paper Association:
  - 1. AF&PA - National Design Specification (NDS) for Wood Construction.
  - 2.

##### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

##### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on void form materials and installation requirements.
- C. Shop Drawings:

1. Indicate:
  - a. Formwork, shoring, and reshoring.
  - b. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
  - c. Means of leakage prevention for concrete exposed to view in finished construction.
  - d. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift, and height of drop during placement.
  - e. Vertical, horizontal, and special loads according to ACI 347, and camber diagrams when applicable.
  - f. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.
  - g. Procedure and schedule for removal of shores and installation and removal of reshores.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:

1. Coordinate following Subparagraph with requirements specified in QUALIFICATIONS Article.
2. Submit qualifications for licensed professional.

## 1.5 QUALITY ASSURANCE

A. Perform Work according to ACI 347, 301, and 318.

B. For wood products furnished for Work of this Section, comply with AF&PA.

C. Perform Work according to Municipal, State, and Federal standards.

## 1.6 QUALIFICATIONS

A. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Michigan.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept void forms on Site in manufacturer's original packaging and inspect for damage.

C. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

## PART 2 - PRODUCTS

### 2.1 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.

### 2.2 FORMWORK ACCESSORIES

#### A. Form Ties:

1. Type: Removable.
2. Material: Galvanized.
3. Length: Adjustable.
4. Furnish waterproofing washer.
5. Free of defects capable of leaving holes larger than 1 inch in concrete surface.

#### B. Spreaders:

1. Description: Standard, non-corrosive metal-form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face.
2. Wire ties, wood spreaders, or through bolts are not permitted.

#### C. Form Release Agent:

1. Description: Colorless mineral oil that will not stain concrete or absorb moisture [or impair natural bonding or color characteristics of coating intended for use on concrete].

#### D. Corners:

1. Type: Chamfer,.
2. Size: 3/4 by 3/4 inches.
3. Lengths: Maximum possible.

#### E. Dovetail Anchor Slot:

1. Material: Galvanized steel.
2. Thickness: 22 gage.
3. Filling: Foam.
4. Fasten slot to concrete formwork according to manufacturer instructions, and insert foam filler to prevent concrete from entering slot during pour.

#### F. Flashing Reglets:

1. Material: Galvanized steel.
2. Thickness: 22 gage.
3. Lengths: Maximum possible.
4. Furnish alignment splines for joints.
5. Filling: Foam.
6. Fasten flashing reglet to concrete formwork according to manufacturer instructions, and insert foam to prevent concrete from entering reglet during pour.

#### G. Vapor Retarder:

1. Description: Polyethylene sheet.
2. Thickness: 8 mils.

- H. Bituminous Joint Filler: Comply with ASTM D1751.
- I. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.
  - 1. .

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify lines, levels, and centers before proceeding with formwork.
- C. Verify that dimensions agree with Shop Drawings.
- D. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Engineer before proceeding.

### 3.2 INSTALLATION

- A. Earth Forms: Not permitted.
- B. Formwork:
  - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
  - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
  - 3. Camber forms where necessary to produce level finished soffits unless indicated otherwise on Drawings.
  - 4. Positioning:
    - a. Carefully verify horizontal and vertical positions of forms.
    - b. Correct misaligned or misplaced forms before placing concrete.
  - 5. Complete wedging and bracing before placing concrete.
  - 6. Erect formwork, shoring, and bracing to achieve design requirements according to ACI 318.
  - 7. Stripping:
    - a. Arrange and assemble formwork to permit dismantling and stripping.
    - b. Do not damage concrete during stripping.
    - c. Permit removal of remaining principal shores.
  - 8. Obtain approval of Engineer before framing openings in structural members not indicated on Drawings.
  - 9. Install fillet and chamfer strips on external corners of beams, joists, and columns.
  - 10. Install void forms according to manufacturer instructions.
  - 11. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view.
  - 12. Do not patch formwork.
  - 13. Leave forms in place for minimum number of days according to ACI 347.

C. Form Removal:

1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads, and removal has been approved by Engineer.
2. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
3. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
4. Discard damaged forms.
5. Form Release Agent:
  - a. Apply according to manufacturer instructions.
  - b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
  - c. Do not apply form release agent if concrete surfaces are indicated to receive special finishes or applied coverings that may be affected by agent.
  - d. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
6. Form Cleaning:
  - a. Clean forms as erection proceeds to remove foreign matter within forms.
  - b. Clean formed cavities of debris prior to placing concrete.
  - c. Flush with water or use compressed air to remove remaining foreign matter.
  - d. Ensure that water and debris drain to exterior through cleanout ports.
  - e. Cold Weather:
    - 1) During cold weather, remove ice and snow from within forms.
    - 2) Do not use de-icing salts.
    - 3) Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.
7. Reuse and Coating of Forms:
  - a. Thoroughly clean forms and reapply form coating before each reuse.
  - b. For exposed Work, do not reuse forms with damaged faces or edges.
  - c. Apply form coating to forms according to manufacturer instructions.
  - d. Do not coat forms for concrete indicated to receive "scored finish."
  - e. Apply form coatings before placing reinforcing steel.

D. Forms for Smooth Finish Concrete:

1. Use steel, plywood, or lined-board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full-sized sheets of form liners and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Apply forming and strip wood forms in a manner to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

E. Forms for Surfaces to Receive Membrane Waterproofing:

1. Use plywood or steel forms.
2. After erection of forms, tape form joints to prevent protrusions in concrete.

- F. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
  2. Do not embed wood or uncoated aluminum in concrete.
  3. Obtain installation and setting information for embedded items furnished under other Sections.
  4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
  5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.
- G. Screeds:
1. Set screeds and establish levels for tops of and finish on concrete slabs.
  2. Slope slabs to drain where required or as indicated on Drawings.
  3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms; remove freestanding water.
- H. Screenshot Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle-, pad-, or base-type screed supports that will not puncture membrane.
  2. Staking through membrane is not permitted.
- I. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
  2. Clean forms and surfaces against which concrete is to be placed.
  3. Remove chips, sawdust, and other debris.
  4. Thoroughly blow out forms with compressed air just before concrete is placed.

### 3.3 TOLERANCES

- A. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances according to ACI 117.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspection:
1. Inspect erected formwork, shoring, and bracing to ensure that Work complies with formwork design and that supports, fastenings, wedges, ties, and items are secure.
  2. Notify Engineer after placement of reinforcing steel in forms but prior to placing concrete.
  3. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Reinforcing bars.
  - 2. Welded wire fabric.
  - 3. Reinforcement accessories.
  
- B. Related Requirements:
  - 1. Section 03 10 00 – Concrete Forming and Accessories.
  - 2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 318 - Building Code Requirements for Structural Concrete.
  - 3. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.
  - 4. ACI SP-66 - ACI Detailing Manual.
  
- B. American Welding Society:
  - 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
  
- C. ASTM International:
  - 1. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
  - 2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - 3. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
  - 4. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
  - 5. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
  - 6. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
  - 7. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
  - 8. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
  - 9. ASTM A996 - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

10. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

D. Concrete Reinforcing Steel Institute:

1. CRSI 10-MSP - Manual of Standard Practice.
2. CRSI 10PLACE - Placing Reinforcing Bars.

### 1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with placement of formwork, formed openings, and other Work.

### 1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Indicate bar sizes, spacings, locations, splice locations, and quantities of reinforcing steel.
2. Indicate bending and cutting schedules.
3. Indicate supporting and spacing devices.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Submit certified copies of mill test report of reinforcement materials analysis.

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statement:

1. Welders: Qualify procedures and personnel according to AWS D1.1.

### 1.5 QUALITY ASSURANCE

A. Perform Work according to ACI 301 ACI 318.

B. Prepare Shop Drawings according to ACI SP-66.

C. Perform Work according to Municipal, State, and Federal standards.

### 1.6 QUALIFICATIONS

A. Welders: AWS qualified within previous 12 months for employed weld types.



## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.8 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 REINFORCEMENT

- A. Reinforcing Steel:
  - 1. Comply with ASTM A615.
  - 2. Yield Strength: 60 ksi.
  - 3. Billet Bars: Deformed.
  - 4. Finish: Uncoated.

### 2.2 FABRICATION

- A. Fabricate concrete reinforcement according to ACI 318.
- B. Form standard hooks for, 90-degree bends, stirrups and tie hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters according to ACI 318.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form ties and stirrups from following:
  - 1. Bars No. 10 and Smaller: No. 3 deformed bars.
  - 2. Bars No. 11 and Larger: No. 4 deformed bars.
- F. Splicing:
  - 1. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.
  - 2. Obtain approval of splice locations from Engineer.

## 2.3 ACCESSORY MATERIALS

- A. Tie Wire:
  - 1. Minimum 16 gage, annealed type.
- B. Chairs, Bolsters, Bar Supports, and Spacers:
- C. Size and Shape: To strengthen and support reinforcement during concrete placement conditions.
- D. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

## 2.4 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.
- B. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- C. Certificate of Compliance:
  - 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 2. Specified shop tests are not required for Work performed by approved fabricator.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Place, support, and secure reinforcement against displacement.
- B. Do not deviate from required position beyond specified tolerance.
- C. Do not weld crossing reinforcement bars for assembly except as permitted by Engineer.
- D. Do not displace or damage vapor retarder.
- E. Accommodate placement of formed openings.
- F. Spacing:
  - 1. Space reinforcement bars with minimum clear spacing according to ACI 318.
  - 2. If bars are indicated in multiple layers, place upper bars directly above lower bars.
- G. Maintain minimum concrete cover around reinforcement according to ACI 318 or as shown on the plans.

### 3.2 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Install reinforcement within following tolerances for flexural members, walls, and compression members:

1. Reinforcement Depth Greater Than 8 Inches:
  - a. Depth Tolerance: Plus or Minus 3/8 inch
  - b. Minus 3/8 inch
2. Reinforcement Depth Less Than or Equal to 8 Inches:
  - a. Depth Tolerance: Plus or Minus 1/2 inch
  - b. Minus 1/2 inch

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Perform field inspection and testing according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed inspection and testing firm.
- D. Reinforcement Inspection:
  1. Placement Acceptance: Inspect specified and ACI 318 material requirements and specified placement tolerances.
  2. Welding: Inspect welds according to AWS D1.1.
  3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
  4. Weldability Inspection: Inspect for reinforcement weldability if formed from steel other than ASTM A706.
  5. Continuous Weld Inspection: Inspect reinforcement according to ACI 318.
  6. Periodic Weld Inspection: Inspect other welded connections.

END OF SECTION

## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes Cast-in-Place Concrete for Following Items:
  - 1. Footings.
  - 2. Slabs on grade.
  - 3. Equipment pads.
  
- B. Related Requirements:
  - 1. Section 03 10 00 - Concrete Forming and Accessories.
  - 2. Section 03 20 00 - Concrete Reinforcing.
  - 3. Section 03 39 00 - Concrete Curing.
  - 4. Section 31 23 23 - Fill.

##### 1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 305R - Guide to Hot Weather Concreting.
  - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
  - 4. ACI 308.1 - Specification for Curing Concrete.
  - 5. ACI 318 - Building Code Requirements for Structural Concrete.
  
- B. ASTM International:
  - 1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  - 2. ASTM C33 - Standard Specification for Concrete Aggregates.
  - 3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  - 5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
  - 6. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
  - 7. ASTM C150 - Standard Specification for Portland Cement.
  - 8. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
  - 9. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
  - 10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
  - 11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
  - 12. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
  - 13. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

14. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
15. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
16. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
17. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on joint devices, attachment accessories, admixtures, and mix design.
- C. Design Data:
  1. Submit concrete mix design for each concrete strength.
  2. Submit separate mix designs if admixtures are required for following:
    - a. Hot and cold weather concrete Work.
    - b. Air entrained concrete Work.
  3. Identify mix ingredients and proportions, including admixtures.
  4. Identify chloride content of admixtures and whether or not chlorides were added during manufacture.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit installation procedures and interfacing required with adjacent Work.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

### 1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

### 1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 301.

- B. Comply with ACI 305R when pouring concrete during hot weather.
- C. Comply with ACI 306.1 when pouring concrete during cold weather.
- D. Acquire cement and aggregate from one source for Work.
- E. Perform Work according to Municipal, State, and Federal standards.

## 1.7 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum seven days.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, water method.

### 2.2 MATERIALS

- A. Concrete:
  - 1. Cement:
    - a. Comply with ASTM C150, Type IIA - Air Entraining.
    - b. Type: Portland.
  - 2. Normal Weight Aggregates:
    - a. Comply with ASTM C33.
    - b. Coarse Aggregate Maximum Size: According to ACI 301.
  - 3. Water:
    - a. Comply with ACI 318.
    - b. Potable, without deleterious amounts of chloride ions.
- B. Admixtures:
  - 1. Air Entrainment: Comply with ASTM C260.
  - 2. Chemical:
    - a. Comply with ASTM C494.
    - b. Type A - Water Reducing.
    - c. Type B - Retarding.
    - d. Type C - Accelerating.
    - e. Type D - Water Reducing and Retarding.
    - f. Type E - Water Reducing and Accelerating.
    - g. Type F - Water Reducing, High Range.
    - h. Type G - Water Reducing, High Range, and Retarding.
  - 3. Fly Ash: Comply with ASTM C618, Class F or C.

4. Silica Fume: Comply with ASTM C1240.
5. Slag:
  - a. Description: Ground-granulated blast-furnace slag.
  - b. Comply with ASTM C989.
  - c. Grade 100 or 120.
6. Plasticizing:
  - a. Comply with ASTM C1017.
  - b. Type II, plasticizing and retarding.

## 2.3 CONCRETE MIX

- A. Select proportions for normal weight concrete according to ACI 301, Method 1.
- B. Concrete mixtures, general
  1. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both.
  2. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
    - a. Fly Ash: 25%
    - b. Ground Granulated Blast-Furnace Slag: 50%
    - c. Combined Fly Ash and Ground Granulated Blast-Furnace Slag: 50%
    - d. Portland cement minimum, with fly ash not exceeding 25%
  3. Limit water-soluble, chloride-ion content in hardened concrete to 0.15% by weight of cement.
  4. Admixtures: Use admixtures according to manufacturer's written instructions.
    - a. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
    - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
    - c. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
    - d. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having a total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
      - 1) Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure: 5.0 percent.
      - 2) Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent.
- C. Concrete mixtures for building elements:
  1. Class A – Structural Concrete:
    - a. Minimum Compressive Strength: 3000 psi at 7 days.
    - b. Minimum Compressive Strength: 4000 psi at 28 days.
    - c. Slump Limit: 4-1 inches.
  2. Class B – Mud Mat Concrete or Slab On Fill Concrete:
    - a. Minimum Compressive Strength: 3000 psi at 7 days.
    - b. Minimum Compressive Strength: 4000 psi at 28 days.

- c. Slump Limit: 4-1 inches.
  - 3. Class C – Fill or Superstructure Concrete
    - a. Minimum Compressive Strength: 3000 psi at 7 days.
    - b. Minimum Compressive Strength: 4000 psi at 28 days.
    - c. Slump: 4-1 inches.
- D. Admixtures:
  - 1. Include admixture types and quantities indicated in concrete mix designs only if approved by Engineer.
  - 2. Cold Weather:
    - a. Use accelerating admixtures in cold weather.
    - b. Use of admixtures will not relax cold-weather placement requirements.
  - 3. Hot Weather: Use set-retarding admixtures.
  - 4. Use calcium chloride only if approved by Engineer.
  - 5. Add air entrainment admixture to concrete mix for Work exposed to freezing and thawing or deicing chemicals.
  - 6. For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fumes, and slag content as required.
- E. Average Compressive Strength Reduction: Not permitted.
- F. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C685.
- G. Site-Mixed Concrete: Mix concrete according to ACI 318.

## 2.4 ACCESSORIES

- A. Bonding Agent:
  - 1. Description: Two-component modified epoxy resin.
- B. Non-shrink Grout:
  - 1. Description: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents.
  - 2. Comply with ASTM C1107.
  - 3. Minimum Compressive Strength: 2,400 psi.
- C. Bentonite Waterstops: Continuous 1 inch x  $\frac{3}{4}$  inch strips, containing 75% bentonite by weight. Proper care and construction procedures shall be used to avoid damaging or displacing the strip while placing concrete. If the material exhibits considerable swelling prior to confinement in the joint, it must be replaced as directed by the Engineer. Joint shall be cleaned from debris and dry prior to replacement. Install per manufacturer's instructions as approved by the Engineer.
- D. Wall Sleeves: HDPE thermoplastic sleeves, "CS" model, used for non-concrete pipe penetrations requiring "Link-seals".
- E. Expansion Joints: ANSI/ASTM D1751, fiber type; 1/4 inch to 1 inch thick.
- F. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.



- G. Corners: Chamfered, wood strip type 3/4" x 3/4" size.
- H. Vapor Retarder: Clear polyethylene film, 6 mils thick, with joint tape. Joint tape as recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Previously Placed Concrete:
  - 1. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
  - 2. Remove laitance, coatings, and unsound materials.
- C. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- D. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- E. Remove water from areas receiving concrete before concrete is placed.

### 3.3 INSTALLATION

- A. Placing Concrete:
  - 1. Place concrete according to ACI 301.
  - 2. Notify testing laboratory and Engineer minimum 48 hours prior to commencement of operations.
  - 3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, and existing utilities are not disturbed during concrete placement.
  - 4. Install vapor retarder under interior slabs on grade according to ASTM E1643.
  - 5. Lap joints minimum 6 inches and seal watertight by taping edges and ends.
  - 6. Repairs:
    - a. Repair vapor retarder damaged during placement of concrete reinforcement.
    - b. Using vapor retarder material, lap over damaged areas minimum 6 inches and seal watertight.
  - 7. Joint Filler:

- a. Separate slabs on grade from vertical surfaces with joint filler.
  - b. Place joint filler in floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
  - c. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
8. Joint Devices:
- a. Coordination: Install construction joint devices in coordination with floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
  - b. Install joint device anchors, maintaining correct position to allow joint cover to be flush with floor and wall finish.
  - c. Install joint covers in longest practical length when adjacent construction activity is complete.
9. Deposit concrete at final position, preventing segregation of mix.
10. Place concrete in continuous operation for each panel or section as determined by predetermined joints.
11. Consolidate concrete.
12. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
13. Place concrete continuously between predetermined expansion, control, and construction joints.
14. Do not interrupt successive placement and do not permit cold joints to occur.
15. Place floor slabs in indicated checkerboard or saw-cut pattern.
16. Saw-Cut Joints:
- a. Saw-cut joints within 12 hours after placing.
  - b. Use 3/16 inch thick blade.
  - c. Cut into 1/4 depth of slab thickness.
17. Screeding:
- a. Screed floors and slabs on grade level.
  - b. Surface Flatness: maximum 1/4 inch in 10 feet.

B. Separate Floor Toppings:

- 1. Prior to placing floor topping, remove deleterious material, roughen substrate concrete surface, and broom and vacuum clean.
- 2. Place required dividers and reinforcement and other items to be cast in concrete.
- 3. Apply bonding agent to substrate.

C. Concrete Finishing:

- 1. Provide formed concrete surfaces to be left exposed with smooth finish.

D. Curing and Protection:

- 1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- 2. Protect concrete footings from freezing for minimum of five days.
- 3. Maintain concrete with minimal moisture loss at relatively constant temperature for period as necessary for hydration of cement and hardening of concrete.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

- B. Inspection and Testing: Performed by Owner's testing laboratory according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Concrete Inspections:
  - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
  - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- F. Strength Test Samples:
  - 1. Sampling Procedures: Comply with ASTM C172.
  - 2. Cylinder Molding and Curing Procedures:
    - a. Comply with ASTM C31.
    - b. Cylinder Specimens: Field cured.
  - 3. Sample concrete and make one set of three cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
  - 4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
  - 5. Make one additional cylinder during cold weather concreting and field cure.
- G. Field Testing:
  - 1. Slump Test Method: Comply with ASTM C143.
  - 2. Air Content Test Method: Comply with ASTM C173.
  - 3. Temperature Test Method: Comply with ASTM C1064.
  - 4. Compressive Strength Concrete:
    - a. Measure slump and temperature for each sample.
    - b. Measure air content in air-entrained concrete for each sample.
- H. Cylinder Compressive Strength Testing:
  - 1. Test Method: Comply with ASTM C39.
  - 2. Test Acceptance: According to ACI 318.
  - 3. Test one cylinder at seven days.
  - 4. Test one cylinder at 28 days.
  - 5. Retain one cylinder for 30 days for testing when requested by Engineer.
  - 6. Dispose of remaining cylinders if testing is not required.
- I. Core Compressive Strength Testing:
  - 1. Sampling and Testing Procedures: Comply with ASTM C42.
  - 2. Test Acceptance: According to ACI 318.
  - 3. Drill three cores for each failed strength test from failed concrete.
- J. Patching:
  - 1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
  - 2. Honeycombing or Embedded Debris in Concrete:

- a. Not acceptable.
- b. Notify Engineer upon discovery.
3. Patch imperfections according to ACI 301.

K. Defective Concrete:

1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
2. Repair or replacement of defective concrete will be determined by Engineer.
3. Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION

SECTION 03 39 00  
CONCRETE CURING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Initial and final curing of horizontal concrete surfaces.

1.2 RELATED SECTIONS

- A. Section 033000 – Cast-In-Place Concrete.

1.3 REFERENCES

- A. ACI 301 – Structural Concrete for Buildings.
- B. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.
- C. ACI 308 - Standard Practice for Curing Concrete.
- D. ASTM C171 - Sheet Materials for Curing Concrete.
- E. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Product Data: Provide data on curing compounds, product characteristics, compatibility and limitations.
- C. Manufacturer's Installation Instructions: Indicate criteria for preparation and application.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and 308.
- B. Maintain one copy of document on site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Section 016000.
- B. Deliver curing materials in manufacturer's packaging including application instructions.

## 2. PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Liquid Membrane Forming Curing Compound ASTM C309 Type 1 Class B, liquid acrylate type, clear, without fugitive dye; curing compounds shall not contain ingredients which might stain through, injure the concrete or prevent a good bond for subsequent coatings or finishes; manufactured by Sonneborn Building Products or equal.
- B. Absorptive Mats ASTM C171, cotton fabric or burlap-polyethylene, minimum 8 oz/sq yd. bonded to prevent separation during handling and placing.
- C. Water: Potable and not detrimental to concrete.

## 3. PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 017000 – Execution and closeout requirements for application examination.
- B. Verify that substrate surfaces are ready to be cured.

### 3.2 EXECUTION - HORIZONTAL SURFACES

- A. Cure slabs in accordance with ACI 308.
- B. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
- C. Membrane Curing Compound: Apply curing compound in accordance with manufacturer's instructions.

### 3.3 EXECUTION - VERTICAL SURFACES

- A. Cure surfaces in accordance with ACI 308.
- B. Spraying: Spray water over surfaces and maintain wet for 7 days.
- C. Membrane Curing Compound: Apply curing compound in accordance with manufacturer's instructions.

### 3.4 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 015000.

END OF SECTION

## SECTION 04 01 00

### MAINTENANCE OF MASONRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Water cleaning of surfaces.
2. Replacement of damaged masonry.
3. Power wash cleaning of concrete surfaces.
4. Repointing of mortar joints.
5. Repair of damaged masonry.

###### B. Related Requirements:

1. Section 040500 - Masonry Mortaring and Grouting: Mortar and grout materials, procedures for new Work, mortar mix requirements, and mortar application.
2. Section 079000 - Joint Protection: Sealants, sealers, and gaskets for sealing joints.
3. Section 099000 - Painting and Finishes.
4. Section 015000 - Temporary Facilities and Controls.

##### 1.2 REFERENCE STANDARDS

###### A. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.
2. NCMA TEK 8-4A - Cleaning Concrete Masonry.

##### 1.3 SUBMITTALS

###### A. Section 013300 - Submittal Procedures: Requirements for submittals.

###### B. Product Data: Submit manufacturer information on cleaning compounds, and cleaning solutions.

###### C. Shop Drawings:

1. Indicate setting details of cut stone, details of special brick shapes, and special supports.
2. Indicate details for shoring, bracing, and temporary or permanent supports.

###### D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

###### E. Manufacturer Instructions: Submit installation procedures for products selected for use, conditions requiring special attention, and protection requirements.

###### F. Qualifications Statements:

1. Submit qualifications for manufacturer and applicator.
2. Submit manufacturer's approval of applicator.

#### 1.4 QUALITY ASSURANCE

- A. Perform Work according to ACI 530/530.1.
- B. Maintain a copy of each standard affecting Work of this Section on Site.

#### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Applicator: Company specializing in performing Work of this Section with minimum two years' documented experience and approved by manufacturer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept new, re-used masonry units on Site, neatly stacked and tied on pallets, and inspect for damage.
- C. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Store abrasive blasting and cleaning materials in manufacturer packaging.
  - 3. Store mortar ingredients in manufacturer packaging, or if delivered loose, with adequate weatherproof covering.

#### 1.7 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Cold Weather Requirements: Comply with ACI 530/530.1 if ambient temperature or temperature of masonry units is less than 40 degrees F (4 degrees C).
- C. Hot Weather Requirements: Comply with ACI 530/530.1 if ambient temperature is greater than 100 degrees F (38 degrees C), or if ambient temperature is greater than 90 degrees F (32 degrees C) with wind velocity greater than 8 mph (13 km/h).

### PART 2 - PRODUCTS

#### 2.1 MASONRY RESTORATION AND CLEANING



- A. Manufacturers:
  - 1. Prosoco, Inc: 3741 Greenway Circle  
Lawrence, KS 66046-5441  
Tel.: (800) 255-4255  
Fax: (800) 830-9797  
www.prosoco.com
  - 2. Substitutions: As specified in Section 016000 - Product Requirements.

## 2.2 MATERIALS

- A. Cleaning Agent: Detergent Trisodium Phosphate type.
- B. Mortar and Grout Materials: As specified in Section 040500 - Masonry Mortaring and Grouting.
- C. Masonry Units: Section 040500 - Masonry Mortaring and Grouting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that surfaces to be cleaned and pointed are ready for Work of this Section.

### 3.2 PREPARATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for application preparation.
- B. Protect elements surrounding Work of this Section from damage or disfiguration.
- C. Exterior Concrete Surfaces Scheduled to Receive Sealing: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- D. Immediately remove stains, efflorescence, or other excess resulting from Work of this Section.
- E. Protect roof membrane and flashings from damage by laying 1/2-inch (13-mm) plywood on roof surfaces over full extent of Work area and traffic route.

- F. Provide Architect/Owner approved dams to divert flowing water to exterior drains and floor drains.
- G. Carefully remove and store fixtures, fittings, hardware, and accessories.
- H. Close off, seal, mask, and board up areas, landscaping, materials, and surfaces adjacent to Work of this Section to protect from damage.
- I. Construct dustproof and weatherproof partitions to close off occupied areas during Work.

### 3.3 INSTALLATION

#### A. Rebuilding:

1. Cut out damaged and deteriorated masonry in manner to prevent damage to adjacent remaining materials.
2. Needle, shore, or support structure in advance of cutting out units to maintain stability of remaining materials.
3. Cut away loose or unsound adjoining masonry, and mortar as directed by Architect/Owner to provide firm and solid bearing for new Work.
4. Build in new, reclaimed masonry units following procedures for new Work as specified in Section 040500 - Masonry Mortaring and Grouting, and Section 042000 - Unit Masonry.
5. Mortar Mix: Colored and proportioned to match existing work or as specified in Section 040500 - Masonry Mortaring and Grouting.
6. Ensure that anchors, ties, reinforcing, stone cramps and dowels, and flashings are correctly located and built in.
7. Install built-in masonry work to match and align with existing work, with joints and coursing true and level and faces plumb and in line.
8. Build in openings, accessories, and fittings.

#### B. Repointing:

1. Cut out loose or disintegrated mortar in joints to minimum 1/2-inch (6-mm) depth or until sound mortar is reached.
2. Use hand tools and/or power tools only after test cuts determine no resulting damage to masonry units.
3. Do not damage masonry units.
4. When cutting is complete, remove dust and loose material by brushing or with air jet.
5. Mortaring:
  - a. Premoisten joint and apply mortar as specified in Section 040500 - Masonry Mortaring and Grouting.
  - b. Pack tightly in maximum 1/4-inch (6-mm) layers.
  - c. Form smooth, compact joint to match existing.
  - d. Moist cure for 72 hours.
6. Wet Sand Cleaning: Remove existing exterior paint using wet sand method.

#### C. Cleaning of New Masonry:

1. Verify that mortar is fully set and cured.
2. Clean surfaces and remove large particles with wood scrapers or brass or nylon wire brushes.
3. Non-acidic Solution:

- a. Scrub walls with Trisodium Phosphate type detergent solution using stiff brush.
- b. Thoroughly rinse and wash off cleaning solution, dirt, and mortar crumbs using clean, pressurized water.

#### 3.4 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.
- B. As Work proceeds and upon completion of Work, remove excess mortar, smears, and droppings.
- C. Clean surrounding surfaces.

END OF SECTION

SECTION 04 05 00  
MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mortar and grout for masonry.

1.2 RELATED WORK

- A. Section 042000 – Unit Masonry.
- B. Section 033000 – Cast-In-Place Concrete.

1.3 REFERENCES

- A. ASTM C91 - Masonry Cement.
- B. ASTM C144 - Aggregate for Masonry Mortar.
- C. ASTM C150 - Portland Cement.
- D. ASTM C207 - Hydrated Lime for Masonry Purposes.
- E. ASTM C270 - Mortar for Unit Masonry.
- F. ASTM C387 - Packaged, Dry, Combined Materials, for Mortar and Concrete.
- G. ASTM C404 - Aggregates for Masonry Grout.
- H. ASTM C476 - Grout for Masonry.
- I. ASTM C1019 - Method of Sampling and Testing Grout.
- J. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.4 SUBMITTALS

- A. Include design mix, indicate Proportion or Property Method used, required environmental conditions, and admixture limitations.
- B. Submit test reports on grout indicating conformance to ASTM C476.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect per manufacturer's recommendations.
- B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and

foreign matter.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperatures to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.

#### 1.7 MIX TESTS

- A. Test mortar and grout.
- B. Testing of Mortar Mix: In accordance with ASTM C780.
- C. Test mortar mix for compressive strength 1800 psi.
- D. Testing of Grout Mix: In accordance with ASTM C1019.

### PART 2 PRODUCTS

#### 2.1 MORTAR

- A. Exterior Walls - S mortar standard color block.

#### 2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type II, Gray, color.
- B. Masonry Cement: ASTM C91, Type S.
- C. Mortar Aggregate: ASTM C144, standard masonry type.
- D. Grout Aggregate: ASTM C404.

#### 2.3 GROUT FINE AGGREGATE:

- A. Masons sand; 70 percent by volume.
- B. Water: Clean and potable.
- C. Bonding Agent: Portland Cement and 1/10 lime.

#### 2.4 MORTAR COLOR

- A. Exterior Mortar Color: Standard block color.

#### 2.5 ADMIXTURES

- A. Plasticizer: Water reducing type which reduces porosity and absorption to increase bond strength; grout manufacturer's standard.

- B. Water Repellent: Liquid type; Rheopel manufactured by Master Builders Inc., or equal.

## 2.6 MORTAR MIXES

- A. Mortar for Load Bearing Walls and Partitions: ASTM C270, Type S using the Property Method.
- B. Mortar: ASTM C270, Type S using the Property Method.

## 2.7 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
- B. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, retemper only within two hours of mixing.
- E. Use mortar within two hours after mixing at temperatures of 80 degrees F (26 degrees C), or two-and-one-half hours at temperatures under 50 degrees F (10 degrees C).

## 2.8 GROUT MIXES

- A. Engineered Masonry: 3000 psi strength at 28 days; 7-8 inches slump; mixed in accordance with ASTM C476 Fine grout.

## 2.9 GROUT MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C476 Fine grout.
- B. Add admixtures in accordance with manufacturer's instructions. Provide uniformity of mix.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Request inspection of spaces to be grouted.

### 3.2 PREPARATION

- A. Apply bonding agent to existing surfaces.
- B. Plug cleanout holes with block masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

### 3.3 INSTALLATION

- A. Install mortar and grout in accordance with manufacturer's instructions.
- B. Do not displace reinforcement while placing grout.
- C. Remove excess mortar.

END OF SECTION

## SECTION 04 20 00

### UNIT MASONRY

#### 1. 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. Concrete Unit Masonry.
  - 2. Accessories

##### 1.3 RELATED SECTIONS

- A. Section 04 05 00 - Mortar and Grout.
- B. Section 07 90 00 - Caulking and Sealants.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops the following installed compressive strengths (f'm) at 28 days.
  - 1. For Concrete Unit Masonry: As follows, based on net area:
    - a. f'm = 1500 psi (10.3 MPa).

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not install until they are in an air-dried condition.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.



## 1.6 PROJECT CONDITIONS

- A. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit masonry damaged by frost or freezing conditions. Comply with the following requirements:
  - 1. Cold-Weather Construction: When the ambient temperature is within the limits indicated, use the following procedures:
    - a. 40 to 32 deg F (4 to 0 deg C): Heat mixing water or sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C).
    - b. 32 to 25 deg F (0 to -4 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry.
    - c. 25 to 20 deg F (-4 to -7 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C) if grouting. Use heat on both sides of walls under construction.
    - d. 20 deg F (-7 deg C) and Below: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C). Provide enclosures and use heat on both sides of walls under construction to maintain temperatures above 32 deg F (0 deg C) within the enclosures.
  - 2. Cold-Weather Protection: When the mean daily temperature is within the limits indicated, provide the following protection:
    - a. 40 to 25 deg F (4 to -4 deg C): Cover masonry with a weather-resistant membrane for 48 hours after construction.
    - b. 25 to 20 deg F (-4 to -7 deg C): Cover masonry with insulating blankets or provide enclosure and heat for 48 hours after construction to prevent freezing. Install wind breaks when wind velocity exceeds 15 mi./h (25 km/h).
    - c. 20 deg F (-7 deg C) and Below: Provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after construction.

3. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried out, but not less than 7 days after completion of cleaning.
- D. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and above.

## 2. PART 2 PRODUCTS

### 2.1 CONCRETE MASONRY UNITS

- A. Concrete Masonry Units: ASTM C 90 and as follows:
1. Furnish and install standard concrete masonry units (C.M.U.) per ACI 530 with horizontal ties and mortar or grout filled cavity where indicated. See exterior elevations and sections/details.
  2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength indicated below:
    - a. 1900 psi (13.1 MPa).
    - b. Not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.
  3. Normal weight units shall be used at concealed and underground conditions.
  4. Light-weight units shall be used at conditions exposed to view.
  5. Size: Nominal modular size of 8" wide x 16" long x 8" high.
  6. Special Units: Provide special units for 90 degree corners, bond beams, lintels, and bullnosed corners.
  7. C.M.U. Color: standard block color.

### 2.2 REINFORCING STEEL

- A. Steel Reinforcing Bars: Material and grade as follows:
1. Billet steel complying with ASTM A 615 (ASTM A 615M).
  2. Epoxy-coated billet steel complying with ASTM A 615 (ASTM A 615M) and ASTM A 775 (ASTM A 775M).
    - a. Grade 60 (Grade 400).
- B. Deformed Reinforcing Wire: ASTM A 496, with ASTM A 153, Class B-2 zinc coating.
- C. Welded-Wire Fabric: ASTM A 185.
- D. Ladder style horizontal reinforcement shall be installed continuous at every second C.M.U. course.

### 2.3 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.
- B. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
  - 1. Headed bolts.
  - 2. Nonheaded bolts, straight.
  - 3. Nonheaded bolts, bent in manner indicated.

#### 2.4 EMBEDDED FLASHING MATERIALS

- A. Asphalt-Coated Copper Flashing: Manufacturer's standard product consisting of sheet copper of weight indicated below, coated with flexible asphalt.
  - 1. Weight: 3 oz./sq. ft. (0.9 kg/sq. m).
  - 2. Weight: 5 oz./sq. ft. (1.5 kg/sq. m).
  - 3. Weight: 7 oz./sq. ft. (2 kg/sq. m).
  - 4. Application: Use where flashing is fully concealed in masonry.
- B. Solder and Sealants for Sheet-Metal Flashings: As specified in Division 7 Section "Flashing and Sheet Metal."
- C. Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.
- D. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
- E. Products: Subject to compliance with requirements, provide one of the following:

#### 2.5 ACCESSORIES

- A. Preformed Control Joints (rubber): Provide with corner and tee accessories, cement fused joints.
- B. Joint Filler: Closed cell polyurethane; oversized 50 percent to joint width; self-expanding.
- C. Building Paper: 15# asphalt saturated felt.
- D. Weep Holes: 1" open head joints spaced not greater than 48" on center.
- E. CMU cell flashing pans with built in adjoining bridge made from recycled polypropylene with chemical stabilizers that prevent UV degradation. Flashing pans have a sloped design to direct moisture to the integrated weep spout. Designed to be built into mortar bed joints to expel moisture to the exterior of CMU walls.
  - 1. Manufacturer: Mortar Net Solutions (BlockFlash) or equal. Tel. (800) 664-6638.

#### 2.6 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.
- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated below without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned.
  - 1. For masonry not subject to metallic oxidation stains, use formulation consisting of a concentrated blend of surface-acting acids, chelating, and wetting agents.
  - 2. For dark-colored masonry not subject to metallic oxidation stains, use formulation consisting of a liquid blend of surface-acting acids and special inhibitors.
  - 3. For masonry subject to metallic oxidation stains, use formulation consisting of a liquid blend of organic and inorganic acids and special inhibitors.
  - 4. Available Products: Subject to compliance with requirements, products that may be used to clean unit masonry surfaces include, but are not limited to, the following:
  - 5. Products: Subject to compliance with requirements, provide one of the following:
    - a. 202 New Masonry Detergent; Diedrich Technologies, Inc.
    - b. 200 Lime Solv; Diedrich Technologies, Inc.
    - c. 202V Vana-Stop; Diedrich Technologies, Inc.
    - d. Sure Klean No. 600 Detergent; ProSoCo, Inc.
    - e. Sure Klean No. 101 Lime Solvent; ProSoCo., Inc.
    - f. Sure Klean Vana Trol; ProSoCo, Inc.

### 3. PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit masonry. Do not proceed with installation until unsatisfactory conditions have been corrected.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.
- B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

#### 3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completion of masonry. After installing equipment, complete masonry to match construction immediately adjacent to the opening.
- B. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.

### 3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arrises, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), nor 3/8 inch in 20 feet (10 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For vertical alignment of head joints, do not exceed plus or minus 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For top surface of bearing walls, do not exceed 1/8 inch (3 mm) in 10 feet (3 m), nor 1/16 inch (1.5 mm) within width of a single unit.
- C. Variation in Mortar-Joint Thickness: Do not vary from bed-joint thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary bed-joint thickness from bed-joint thickness of adjacent course by more than 1/8 inch (3 mm). Do not vary from head-joint thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary head-joint thickness from adjacent head-joint thickness by more than 1/8 inch (3 mm). Do not vary from collar-joint thickness indicated by more than minus 1/4 inch (6 mm) or plus 3/8 inch (10 mm).

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
- B. Lay walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

END OF SECTION

## SECTION 05 52 00

### METAL RAILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Aluminum railings and fittings.

###### B. Related Requirements:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of anchors, as specified in this Section, in concrete.

##### 1.2 REFERENCE STANDARDS

###### A. Aluminum Association:

1. AA ADM 1 - Aluminum Design Manual.
2. AA ASM 35 - Aluminum Sheet Metal Work in Building Construction.

###### B. American Architectural Manufacturers Association:

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

###### C. ASTM International:

1. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. ASTM B241 - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
4. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

###### D. National Association of Architectural Metal Manufacturers:

1. NAAMM Metal Finishes Manual.

###### E. National Ornamental & Miscellaneous Metals Association:

1. NOMMA Guideline 1 - Joint Finishes.

### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statements:
  - 1. Submit qualifications for fabricator and erector.
  - 2. Submit manufacturer's approval of fabricator and erector.

### 1.4 QUALITY ASSURANCE

- A. Perform Work for structural aluminum according to AA ADM 1 and AA ASM 35.
- B. Perform Work of this Section according to ASTM E985.
- C. Finish joints according to NOMMA Guideline 1.
- D. Perform Work according to OSHA and local building code standards.
- E. Maintain one copy of each standard affecting the Work of this Section On-Site.

### 1.5 QUALIFICATIONS

- A. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' documented experience.

### 1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design handrail, guardrail, and attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.
  - 1. Guard Top Rail and Handrail Concentrated Load: 200 lb. applied at any point in any direction.

2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 lb. applied to 1 sq. ft. area.

## 2.2 HANDRAILS, GUARDS and RAILINGS

- A. Substitutions: Section 01 60 00 - Product Requirements.

## 2.3 MATERIALS

- A. Aluminum Railing System:
  1. Rails and Posts: 1-1/2-inch-diameter or as drawings show.
  2. Posts: 1-1/2-inch-diameter or as drawings show.
  3. Fittings: Elbows, T-shapes, wall brackets, escutcheons.
  4. Mounting: Adjustable brackets and flanges.
  5. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
  6. Splice Connectors: Aluminum collars.

## 2.4 FABRICATION

- A. Fit and shop-assemble components in largest practical sizes for delivery to Site.
- B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate Site assembly and installation.
- C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Exterior Components: Continuously seal joined pieces by continuous welding. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.
- G. Interior Components: Continuously seal joined pieces by continuous welding.
- H. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- I. Accurately form components to suit stairs and landings, to each other and to building structure.
- J. Accommodate expansion and contraction of members and building movement without damage to connections or members.



## 2.5 MANUFACTURERS

- A. Railing Works, Architectural Railing Systems
- B. Superior Aluminum Products
- C. Ideal Shield
- D. Approved equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field conditions are acceptable and are ready to receive Work.
- C. Verify that concealed blocking and reinforcement are installed and correctly located to receive wall-mounted handrails.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Supply items required to be cast into concrete with setting templates to appropriate Sections.

### 3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Anchor railings to structure with anchors, as indicated on drawings.
- C. Field-weld anchors as indicated on Drawings. Touch up welds with primer. Grind welds smooth.
- D. Conceal bolts and screws whenever possible.
- E. Installation Standards: Install Work according to OSHA and local building code standards.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.
- C. Maximum Offset from Alignment: 1/4 inch.

D. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

## SECTION 05 52 00

### METAL RAILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Steel pipe railings, balusters, and fittings.
2. Handrails.

###### B. Related Requirements:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of anchors, as specified in this Section, in concrete.
2. Section 05 12 00 - Structural Steel Framing.
3. Section 05 51 00 - Metal Stairs: Handrails other than those specified in this Section.
4. Section 09 90 00 - Painting and Coating: Paint finish.

##### 1.2 REFERENCE STANDARDS

###### A. Aluminum Association:

1. AA ADM 1 - Aluminum Design Manual.
2. AA ASM 35 - Aluminum Sheet Metal Work in Building Construction.

###### B. American Architectural Manufacturers Association:

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

###### C. ASTM International:

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
5. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
6. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

7. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
8. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
9. ASTM A743 - Standard Specification for Castings, Iron Chromium, Iron Chromium Nickel, Corrosion Resistant, for General Application.
10. ASTM B177 - Standard Guide for Engineering Chromium Electroplating.
11. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
12. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
13. ASTM B241 - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
14. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

D. National Association of Architectural Metal Manufacturers:

1. NAAMM Metal Finishes Manual.

E. National Ornamental & Miscellaneous Metals Association:

1. NOMMA Guideline 1 - Joint Finishes.

F. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

### 1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

E. Qualifications Statements:

1. Submit qualifications for fabricator and erector.
2. Submit manufacturer's approval of fabricator and erector.

### 1.4 QUALITY ASSURANCE

A. Perform Work for structural aluminum according to AA ADM 1 and AA ASM 35.

B. Perform Work of this Section according to ASTM E985.

C. Finish joints according to NOMMA Guideline 1.

D. Perform Work according to OSHA and local building code standards.

E. Maintain one copy of each standard affecting the Work of this Section On-Site.

## 1.5 QUALIFICATIONS

- A. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' documented experience.

## 1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design handrail, guardrail, and attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.
  - 1. Guard Top Rail and Handrail Concentrated Load: 200 lb. applied at any point in any direction.
  - 2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
  - 3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 lb. applied to 1 sq. ft. area.

### 2.2 HANDRAILS AND RAILINGS

- A. Substitutions: Section 01 60 00 - Product Requirements.

### 2.3 MATERIALS

- A. Steel Railing System:
  - 1. Pipe: ASTM A53, Grade B, Schedule 40.
  - 2. Rails and Posts: 1-1/2-inch-diameter steel pipe or as drawings show; welded joints.
  - 3. Posts: 1-1/2-inch-diameter steel pipe or as drawings show; welded joints.
  - 4. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast steel.
  - 5. Mounting: Adjustable brackets and flanges.
  - 6. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
  - 7. Splice Connectors: Steel welding collars.
  - 8. Galvanizing: According to ASTM A123; hot-dip galvanized after fabrication.
  - 9. Touchup Primer for Galvanized Surfaces: SSPC Paint 20, Type I - Inorganic, zinc-rich.

### 2.4 FABRICATION

- A. Fit and shop-assemble components in largest practical sizes for delivery to Site.

- B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate Site assembly and installation.
- C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Exterior Components: Continuously seal joined pieces by continuous welding. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.
- G. Interior Components: Continuously seal joined pieces by continuous welding.
- H. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- I. Accurately form components to suit stairs and landings, to each other and to building structure.
- J. Accommodate expansion and contraction of members and building movement without damage to connections or members.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field conditions are acceptable and are ready to receive Work.
- C. Verify that concealed blocking and reinforcement are installed and correctly located to receive wall-mounted handrails.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean and strip galvanized steel items to bare metal where Site welding is required.
- C. Supply items required to be cast into concrete with setting templates to appropriate Sections.

### 3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Anchor railings to structure with anchors, as indicated on drawings.
- C. Field-weld anchors as indicated on Drawings. Touch up welds with primer. Grind welds smooth.
- D. Conceal bolts and screws whenever possible.
- E. Installation Standards: Install Work according to OSHA and local building code standards.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.
- C. Maximum Offset from Alignment: 1/4 inch.
- D. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 00  
ROUGH CARPENTRY

1. 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. Framing with dimension lumber.
  - 2. Framing with engineered wood products.
  - 3. Wood furring, grounds, nailers, and blocking.
  - 4. Sheathing.
  - 5. Utility shelving.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 6 Section "Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.
- B. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
  - 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

2. PART 2 PRODUCTS

2.1 LUMBER, GENERAL

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.



- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
  1. NELMA - Northeastern Lumber Manufacturers Association.
  2. NLGA - National Lumber Grades Authority (Canadian).
  3. RIS - Redwood Inspection Service.
  4. SPIB - Southern Pine Inspection Bureau.
  5. WCLIB - West Coast Lumber Inspection Bureau.
  6. WWPA - Western Wood Products Association.
  
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
  1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.

## 2.2 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
  
- B. Framing Other than Non-Load-Bearing Partitions: Provide framing of the following grade and species:
  1. Grade: No. 2 or better.
  2. Species and Grade: Any species of machine stress-rated (MSR) dimension lumber with a grade of 1800f-1.6E.

## 2.3 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
  
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
  
- C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
  
- D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

## 2.4 ENGINEERED WOOD PRODUCTS

- A. General: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that evidence compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Laminated-Veneer Lumber: Lumber manufactured by laminating wood veneers in a continuous press using an exterior-type adhesive complying with ASTM D 2559 to produce members with grain of veneers parallel to their lengths and complying with the following requirements:
1. Extreme Fiber Stress in Bending: 2500 psi (17 MPa) for 12-inch nominal- (286-mm actual-) depth members.
  2. Modulus of Elasticity: 2,000,000 psi (13 800 MPa).
  3. Tension Parallel to Grain: 1850 psi (13 MPa).
  4. Compression Parallel to Grain: 2800 psi (19 MPa).
  5. Compression Perpendicular to Grain: 400 psi (3 MPa) perpendicular to and 500 psi (3.5 MPa) and parallel to glue line.
  6. Horizontal Shear: 285 psi (2 MPa) perpendicular to and 190 psi (1.3 MPa) parallel to glue line.
- C. Parallel-Strand Lumber: Lumber manufactured by laying up wood strands using an exterior-type adhesive complying with ASTM D 2559, and cured under pressure to produce members with grain of strands parallel to their lengths and complying with the following requirements:
1. Extreme Fiber Stress in Bending: 2900 psi (20 MPa) for 12-inch nominal- (286-mm actual-) depth members.
  2. Modulus of Elasticity: 2,000,000 psi (13 800 MPa).
  3. Tension Parallel to Grain: 2400 psi (16.5 MPa).
  4. Compression Parallel to Grain: 2900 psi (20 MPa).
  5. Compression Perpendicular to Grain: 400 psi (3 MPa) perpendicular to and 600 psi (4.1 MPa) and parallel to wide face of strands.
  6. Horizontal Shear: 210 psi (1.4 MPa) perpendicular to and 290 psi (2 MPa) and parallel to wide face of strands.

## 2.5 AIR-INFILTRATION BARRIER

- A. Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
- B. Air retarder complying with ASTM E 1677; made from polyolefins; either cross-laminated films, woven strands, or spunbonded fibers; coated or uncoated; with or without perforations to transmit water vapor but not liquid water; and as follows:
1. Minimum Thickness: 3 mils (0.08 mm).
  2. Minimum Water-Vapor Transmission: 10 perms (575 ng/Pa x s x sq. m) when tested according to ASTM E 96, Procedure A.
  3. Maximum Flame Spread: 25 per ASTM E 84.
  4. Minimum Allowable Exposure Time: 3 months.

## 2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacturer.
  - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M)
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

### 3. PART 3 EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Apply field treatment complying with AWWA M4 to cut surfaces of preservative-treated lumber and plywood.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
  - 2. Published requirements of metal framing anchor manufacturer.
  - 3. "Recommended Nailing Schedule" of referenced framing standard and with AFPA's "National Design Specifications for Wood Construction."
  - 4. "Table 23-I-Q--Nailing Schedule" of the Uniform Building Code.
  - 5. "Table 2305.2--Fastening Schedule" of the BOCA National Building Code.
  - 6. "Table 1705.1--Fastening Schedule," of the Standard Building Code.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite

side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

- G. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.
- H. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

### 3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Install permanent grounds of dressed, preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Install framing members of size and at spacing indicated.
- D. Do not splice structural members between supports.
- E. Firestop concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where firestopping is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal- (38-mm actual-) thickness lumber of same width as framing members.

END OF SECTION

## SECTION 06 20 00

### FINISH CARPENTRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Finish Carpentry:
    - a. Standing and running trim.
- B. Related Requirements:
  - 1. Section 06 10 00 - Rough Carpentry.
  - 2. Section 09 90 00 - Painting and Finishes.

##### 1.2 REFERENCE STANDARDS

- A. American National Standards Institute:
  - 1. ANSI A135.4 - Basic Hardboard.
  - 2. ANSI A208.1 - Mat-Formed Wood Particleboard.
- B. APA-The Engineered Wood Association:
  - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- C. ASTM International:
  - 1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 2. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 3. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 4. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
  - 5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 6. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- D. Forest Stewardship Council:
  - 1. FSC Guidelines - Forest Stewardship Council Guidelines.
- E. Hardwood Plywood and Veneer Association:
  - 1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

##### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

- B. Coordinate Work of this Section with electrical rough-in, installation of associated and adjacent components, and mechanical rough-in.

#### 1.4 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for Work sequencing.
- B. Sequence Work to ensure utility connections are achieved in orderly and expeditious manner.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on:
  - 1. Fire-retardant treatment materials and application instructions.
  - 2. Preservative treatment materials and application instructions.
  - 3. Plastic-finish carpentry products.
  - 4. Attachment hardware and finish hardware.
- C. Shop Drawings:
  - 1. Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- D. Samples:
  - 1. Submit two samples of finish plywood, 8 x 10 inches (200 x 250 mm) in size, illustrating wood grain and specified finish.
  - 2. Submit two samples of wood trim 10 in (250 mm) long.
  - 3. Submit two samples of synthetic lumber, hardware items, and shop finishes.
- E. Qualification Statements:
  - 1. Submit manufacturer and fabricator experience qualifications.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work according to AWS Section 6 and Section 7 custom grade and premium grade.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' production experience similar to this Project.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' production experience similar to this Project.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Protect Work from moisture damage.
- C. Maintain storage space relative humidity within ranges indicated in AWS Section 2.

## 1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Maintain storage space relative humidity within ranges indicated in AWS, Section 2.

## 1.10 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 FINISH CARPENTRY

- A. Standing and Running Trim: Softwood lumber and plywood, Hardwood lumber and plywood; preservative treated, Plastic trim, Plastic boards, Plastic panels, Plastic lumber, Plastic trim and boards, Plastic panels and lumber.
  - 1. Profile: Sizes and profiles as indicated on Drawings.
  - 2. Opaque Finished Trim: AWS Section 6; custom or premium grade.
  - 3. Transparent Finished Trim: AWS Section 6; custom or premium grade.

### 2.2 EXTERIOR MATERIALS

- A. Exterior Softwood Lumber: Western red cedar, douglas fir, ponderosa pine, sugar pine, redwood, or other species indicated elsewhere.
  - 1. Cut: Plain sawn or as indicated on drawings.
  - 2. Finger Jointing: Permitted with waterproof adhesives.
- B. Exterior Preservative-Treated Softwood Lumber: Southern yellow pine, douglas fir, ponderosa pine, sugar pine, or other species indicated elsewhere.
  - 1. Cut: Plain sawn or as indicated on drawings.
  - 2. Finger Jointing: Permitted with waterproof adhesives.
- C. Exterior Hardwood Lumber: Honduras mahogany, White oak, Teak, American walnut, or other species indicated elsewhere.
  - 1. Cut: Plain sawn or as indicated on drawings.

2. Finger Jointing: Permitted with waterproof adhesives.

D. Lumber Moisture Content Range: 9 to 15 percent.

### 2.3 WOOD TREATMENT

A. Fire-Retardant Treatment: Chemically treated and pressure impregnated, having flame spread of 25 or less when tested according to ASTM E 84 and showing no evidence of significant progressive combustion when test is continued for an additional 20-minute period, exterior type.

B. Wood Preservative Pressure Treatment: WDMA I.S.4

C. Provide identification on fire-retardant-treated material.

D. Deliver fire-retardant-treated materials cut to required sizes. Minimize field cutting.

E. Moisture Content after Treatment: Re-dried or Kiln dried (KDAT).

1. Lumber: As specified for exterior lumber.

2. Plywood: Maximum 15 percent.

### 2.4 FABRICATION

A. Fabricate finish carpentry to AWS Section 6 custom or premium grade..

B. Shop assemble Work for delivery to Site, permitting passage through building openings.

C. Fit exposed plywood edges with matching hardwood, matching veneer, plastic, or aluminum edging, where indicated. Use one piece for full length only.

D. Shop prepare and identify components for book match grain matching during Site erection.

E. When necessary to cut and fit on-Site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and Site cutting.

### 2.5 FINISHES

A. Sand Work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.

D. Stain, seal and varnish exposed to view surfaces.

E. Seal semi-concealed surfaces.

F. Prime paint/Seal surfaces in contact with cementitious materials.



## 2.6 ACCESSORIES

- A. Fasteners, Bolts, and Anchors: ASTM A153 (A153M), hot-dip galvanized or Type 316 stainless steel.
- B. Concealed Joint Fasteners: Threaded steel.
- C. Lumber for Shimming, Blocking, Softwood lumber of southern yellow pine species.
- D. Primer: Acrylic primer sealer type.
- E. Wood Filler: Solvent or Oil base, tinted to match surface finish color.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify adequacy of backing and support framing.
- C. Verify mechanical, electrical, and building items affecting Work of this Section are placed and ready to receive this Work.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Prime paint surfaces of wood items and assemblies to be in contact with cementitious materials.
- C. Prime paint surfaces of wood items and assemblies.

### 3.3 INSTALLATION

- A. Modify and extend existing finish carpentry installations using materials and methods as specified.
- B. Install Work according to AWS Section 6, 7, and manufacturer's instructions.
- C. Set and secure materials and components in place, plumb and level.
- D. Carefully scribe work abutting other components, with maximum gaps of 1/32 in (1 mm). Do not use additional overlay trim to conceal larger gaps.
- E. Site-Applied Wood Treatment:

1. Brush apply one coat of preservative treatment on wood in contact with cementitious materials and roofing and related metal flashings.
2. Treat Site-sawn cuts. Apply preservative to Site-sawn cuts according to WDMA I.S.4.
3. Allow preservative to dry prior to erecting members.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Exterior Finish Carpentry shall conform to AWS Section 6 requirements for the following:
  1. Smoothness.
  2. Gaps.
  3. Flushness.
  4. Flatness.
- C. Stairs, Handrails, and Balusters shall conform to AWS Section 7 requirements for the following:
  1. Smoothness.
  2. Gaps.
  3. Flushness.
  4. Flatness.
  5. Alignment.

END OF SECTION

## SECTION 07190

### VAPOR AND AIR BARRIERS

#### 1. PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Sheet materials to provide a continuous vapor barrier beneath all interior concrete slabs on grade.

##### 1.2 RELATED SECTIONS

- A. Section 03300 – Cast-In-Place Concrete: Vapor barrier under interior slabs on grade.
- B. Section 07900 - Caulking and Sealants: Sealants.

##### 1.3 REFERENCES

- A. ASTM E154 – Under slab Moisture Vapor Barrier.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Materials of this Section shall prevent moisture from migrating upward through concrete slabs.

##### 1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data indicating material characteristics, performance criteria, and limitations.
- C. Manufacturer's Installation Instructions: Indicate preparation and installation requirements, techniques.

##### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during, and after installation.

##### 1.7 SEQUENCING

- A. Sequence Work to permit installation of materials in conjunction with other retardant materials and seals.

##### 1.8 COORDINATION

- A. Coordinate work under provisions of Section 01039.

- B. Coordinate the work of this Section with all Sections referencing this Section.

#### 1.9 WARRANTY

- A. Provide one-year warranty under provisions of Section 01700.

### 2. PART 2 PRODUCTS

#### 2.1 SHEET MATERIALS

- A. Sheet Barrier: Black polyethylene film 6 mil. thick.

#### 2.2 ACCESSORIES

- A. Thinner and Cleaner for Vapor Barrier Sheet: As recommended by sheet material manufacturer.
- B. Tape: Polyethylene self-adhering type, mesh reinforced, 2 inch wide, compatible with sheet material.

### 3. PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify condition of substrate and adjacent materials under provisions of Section 01039.
- B. Verify that surfaces and conditions are ready to accept the Work.

#### 3.2 PREPARATION

- A. Remove loose or foreign matter which might impair adhesion.
- B. Clean and prime substrate surfaces to receive tape in accordance with manufacturers' instructions.

#### 3.3 INSTALLATION

- A. Install sheet materials in accordance with manufacturer's instructions.
- B. Install tape in accordance with manufacturer's instructions.

#### 3.4 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500.
- B. Do not permit adjacent Work to damage Work of this Section.

END OF SECTION

SECTION 07 21 13  
BOARD INSULATION

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation in below grade wall construction.

1.2 RELATED SECTIONS

- A. Section 061000 - Rough Carpentry.

1.3 REFERENCES

- A. ASTM C272 - Water Absorption.
- B. ASTM C518 - Thermal Resistance.
- C. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.
- D. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.
- E. ASTM D1621 - Compressive Strength.
- F. ASTM C203 - Flexural Strength.
- G. ASTM D2126 - Dimensional Stability.

1.4 PERFORMANCE REQUIREMENTS

- A. Materials of this Section shall provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials.
- B. Materials of this Section shall provide continuity of vapor and air barrier at building enclosure elements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Submittals.
- B. Product Data: Provide data on product characteristics, performance criteria and limitations.
- C. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation and installation techniques.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.7 COORDINATION

- A. Coordinate work under provisions of Section 01 10 00 - Summary of Work and Section 01 30 00 - Coordination and Meetings.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

- A. Dow Chemical Company, Product: Styrofoam.
- B. Dow Brand Square Edge or Score Board (below grade exterior).
- C. Dupont, Inc.
- D. Owens Corning.
- E. Approved equal.

2.2 INSULATION MATERIALS - BOARD INSULATION

- A. Polystyrene Insulation:ASTM C578 Type VI; extruded cellular type, conforming to the following.
  - 1. Thermal Resistance: R of 6.5 @40 F per inch of thickness.
  - 2. Thickness: As shown on the drawings.
  - 3. Board Size: 48 inch x 96 inch.
  - 4. Compressive Strength: Minimum 25 psi.
  - 5. Water Absorption:In accordance with ASTM C272; 0.1 percent by volume maximum.
  - 6. Edges:Square edges.

2.3 INSULATION MATERIALS - POLYSTYRENE INSULATION TYPE A

- A. Thermal Resistance:R of 6.5 or greater per inch of thickness.
- B. Thickness: As indicated, minimum 1 1/2 inches for exterior walls. Board Size 48" x 96".
- C. Compressive Strength:Minimum 15 psi
- D. Water Absorption In accordance with ANSI/ASTM D2842, 4 percent by volume maximum edges square.

2.4 ACCESSORIES

- A. Separator Sheet: Black polyfilm 4 mils thick minimum.

- B. Tape: Polyethylene self-adhering type, 2 inch wide.
- C. Insulation Fasteners: Fasteners of galvanized steel, to mechanically fasten insulation to substrate, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place; as recommended by roof membrane manufacturer.
- D. Adhesive: Type recommended by insulation manufacturer for application.

### 3. PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify site conditions.
- B. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.
- C. Verify substrate surface is flat, free of honeycombs, fins, irregularities, and free of materials or substances that may impede adhesive bond.

#### 3.2 INSTALLATION - EXTERIOR WALLS

- A. Apply type of adhesive recommended by insulation board manufacturer.
- B. Install boards on wall surface, vertically.
- C. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.
- D. Tape insulation board joints.

#### 3.3 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500 - Construction Facilities and Temporary Controls.
- B. Protect Work from damage prior to covering insulation.

END OF SECTION

## SECTION 09 90 00

### PAINTING AND FINISHES

#### 1. PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. Surface preparation.
- B. Surface finish schedule.
- C. Color selection schedule.
- D. Applying finishes to existing structures and equipment as specified.

##### 1.2 RELATED WORK

- A. Section 051200 - Structural Steel: Shop primed items.
- B. Section 061000 - Rough Carpentry.
- C. Section 081000 - Metal Doors and Frames.
- D. Section 092500 - Gypsum Drywall.
- E. Section 033000 - Cast-In-Place Concrete
- F. Section 042000 - Masonry

##### 1.3 REFERENCES

- A. ANSI/ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Laquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.
- C. ASTM D4263 - Standard Test Method for indicating moisture in concrete by the plastic sheet method.

##### 1.4 DEFINITIONS

- A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

##### 1.5 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with three years experience.
- B. Applicator: Company specializing in commercial painting and finishing approved by product manufacturer.



## 1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

## 1.7 SUBMITTALS

- A. Submit product data under provisions of Section 013300.
- B. Provide product data on all finishing products.
- C. Submit samples and color charts under provisions of Section 013300.
- D. Submit manufacturer's application instructions under provisions of Section 013300.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 016000.
- B. Store and protect products under provisions of Section 016000.
- C. Deliver products to site in sealed and labelled containers; inspect to verify acceptance.
- D. Container labelling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- E. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
- F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

## 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 72 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

1.10 EXTRA STOCK

- A. Provide a one gallon container of each color and type to Owner. Quart containers will be acceptable for touchup paint and for small items.

2. PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PAINT, PRIMERS, BLOCK FILLER, AND FIELD CATALYZED COATINGS

- A. Coronado Paint Company
- B. Glidden Division I.C.I.
- C. Sherwin Williams.
- D. Substitutions: Under provisions of Section 016000.

2.2 MATERIALS

- A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.
- C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.3 FINISHES

- A. Refer to schedule at end of Section for surface finish and color schedule.

3. PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Plaster and Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
3. Interior Located Wood: 15 percent, measured in accordance with ASTM D2016.
4. Exterior Located Wood: 15 percent, measured in accordance with ASTM D2016.
5. Concrete Floors: 14 percent, measured in accordance with ASTM D4263.

D. Beginning of installation means acceptance of existing surfaces.

### 3.2 PREPARATION

- A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- B. Correct minor defects and clean surfaces which affect work of this Section.
- C. Seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
- G. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved by using a pH pencil or pH range paper, pH should be 11 or less prior to application of coatings.
- H. Copper Surfaces Scheduled for a Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
- I. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.
- J. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- K. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

- L. Exterior Face Brick: Verify that brick installed as part of the work has been cleaned according to Section 4500. Power wash existing face brick scheduled to receive coatings with masonry detergent.
- M. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- N. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- O. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- P. Interior Wood Items Scheduled to Receive Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- Q. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.
- R. Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

### 3.3 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

### 3.4 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Sand lightly between coats to achieve required finish.
- E. Allow applied coat to dry before next coat is applied.

F. Prime back surfaces of interior and exterior woodwork with primer paint.

### 3.5 CLEANING

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

### 3.6 GENERAL FINISH SPECIFICATIONS

#### A. Masonry (M.)

##### 1. M-2 Existing Interior

Surface:

Preparation: Thoroughly wash and rinse surfaces, removing dirt, dust, grease and oil. Use appropriate detergent cleanser. Remove loose or flaking paint and feather sand edges for a smooth uniform surface. Dull glossy surfaces.

Primer: Apply one coat latex primer sealer to exposed bare areas with a coverage of 400 square feet per gallon.

Finish Coats: Apply two coats of 32% volume solids, acrylic latex gloss enamel, at a minimum dry film thickness of 1.4 mils per coat and a coverage of 365 square feet per gallon.

#### B. Ferrous Metals (F.M.)

##### 1. F.M.-1 Exterior/Interior - severe exposure.

Surface

Preparation: SSPC SP6 Commercial Blast Cleaning.

Shop or

Field Coat: Apply one coat of 54% volume solids, two component poly-amide cured high build epoxy primer. At a dry film thickness of 3.0 mils and a coverage of 289 square feet per gallon.

First Coat: Apply one coat of a 56% volume solids, two component poly-amide cured high-build epoxy. At a minimum dry film thickness of 3.0 mils and a coverage of 300 square feet per gallon.

Second Coat: Apply one coat of a 54% volume solids aliphatic polyester polyurethane enamel. At a minimum dry film

thickness of 1.5 mils and a coverage of 577 square feet per gallon.

C. Concrete (C.)

1. C-7 Existing Concrete Floors

Surface:

Preparation: Thoroughly wash and rinse surfaces, removing dirt, dust, grease and oil. Use appropriate detergent cleanser. Remove loose or flaking paint and feather sand edges for a smooth uniform surface. Dull glossy surfaces.

Primer: Apply one coat of epoxy modified acrylic floor finish, thinned 15%, to exposed bare areas, with a coverage of 350 square feet per gallon.

Finish Coat: Apply two coats of epoxy modified acrylic floor finish with a coverage of 350 square feet per gallon.

D. Wood (W.)

1. W-1 Exterior and Interior

Surface

Preparation: Surface must be dry, clean, and free of contaminants. Sand rough areas.

Primer: Apply a 53% volume solids alkyd wood primer at a dry film thickness of 2.0 mils and a coverage of 425 square feet per gallon.

Finish Coats: Apply two coats of a 54% volume solids alkyd enamel, at a dry film thickness of 2.0 mils per coat and a coverage of 400 square feet per gallon.

2. W-1 Exterior Varnish

Surface

Preparation: Surface must be dry, clean, and free of contaminants. Sand rough areas.

Finish Coats: Apply two coats of Minwax Helmsman Spar Urethane, satin finish or equal. Color by Owner.

E. Drywall (D.)

1. D-1. Drywall (Gypsum Board)

Surface

Preparation: Surface must be dry, clean and free of contaminants. Sand joint compound smooth and feather edges.

Finish Coats: Apply two coats of a 43% volume solids acrylic latex at a dry film thickness of 2 mils per coat and a coverage of 345 square feet per gallon.

F. Galvanized Metals (G.)

1. G-1 Interior

Surface Preparation: SSPC-SP1 Solvent Cleaning.

Primer: Apply one coat of Epoxy Zinc Chromate primer poly-amide with 52% solids at a coverage of 375 square feet per gallon.

Finish Coats: Apply two coats of a 56% volume solids, poly-amide cured high-build epoxy at a dry film thickness of 3.0 mils per coat and a coverage of 300 square feet per gallon.

2. G-2 Exterior

Surface Preparation: SSPC-SP1 Solvent Cleaning.

Primer: Apply one coat of Epoxy Zinc Chromate primer poly-amide with 52% solids at a coverage of 375 square feet per gallon.

First Coat: Apply one coat of a 56% volume solids, poly-amide cure high-build epoxy at a dry film thickness of 3.0 mils and a coverage of 300 square feet per gallon.

Finish Coat: Apply one coat of a 54% volume solids, aliphatic polyester polyurethane enamel at a minimum dry film thickness of 1.5 mils and at a coverage of 577 square feet per gallon.

3.8 PAINTS AND COATINGS SCHEDULE

- A. Application: Materials shall be applied to the following surfaces and areas in accordance with the guidelines developed within the "General Finish Specifications".
- B. Finish M-2: Existing interior exposed concrete block.
- C. Finish FM-1: Ferrous materials including, but not limited to, structural steel, miscellaneous metals, doors and frames, non-insulated piping, and equipment not included under Finish FM-2 disturbed or installed as part of the work as indicated in the schedule. Stainless steel, aluminum and plastic components specified with the above items shall be painted only as directed by the Engineer.

- D. Finish G-1: Interior galvanized items, i.e. structural members, frames, exposed ductwork, conduit, etc. disturbed or installed as part of the work and as indicated in the schedule.
- E. Finish G-2: Exterior galvanized items, i.e. structural members, frames, etc. disturbed or installed as part of the work and as indicated in the schedule.
- F. Finish C-7: Existing interior concrete floors and as indicated in the schedule.
- G. Finish W-1: Exposed wood disturbed or installed as part of the work scheduled to receive paint finish.
- H. Finish W-2: Exposed wood disturbed or installed as part of the work scheduled to receive varnish or a stain finish.
- I. Finish D-1: Exposed drywall (gypsum board) disturbed or installed as part of the work and as indicated in the schedule.
- J. Refer to the "Materials and Finishes" schedule in the "Finish Schedules" drawing for more information and for color selections.

END OF SECTION



## SECTION 22 00 00

### PLUMBING

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. Contractor shall provide all labor, materials, equipment, permits, inspection fees, utility company charges, supervision and other items noted in contract General Conditions necessary to yield completely operable and tested systems as shown on the Plans and specified herein. As shown and noted on plans, details, and specifications the plumbing work includes, but is not limited to, the following:
1. Storm water, sanitary, and water piping to 5'-0" outside of building (where the site contractor shall connect.)
  2. Domestic hot and cold water systems from source to all points of use, including water heaters, backflow preventers at locations requiring their use, and chlorination of systems prior to occupancy.
  3. Purchase and installation of potable water meter and strainer assembly including shutoff and bypass, as required by the local municipality.
  4. New plumbing fixtures and trim, wall hydrants or hose bibbs, floor drains, roof drains, cleanouts, emergency shower and eyewash stations, and related items.
  5. Natural gas piping to all points of use, and all necessary costs associated with the gas utility company, including all valves, pressure regulators, and other required system equipment.
  6. Insulation for piping systems and equipment as specified.
  7. Wrapping of all insulation with heavy duty PVC jacket.
- B. Exterior aboveground piping which is not insulated or otherwise covered shall be primed/painted. See Plumbing Plans for special gas painting notes.
- C. Touch-up painting of damaged materials furnished by this contractor and damaged by this contractor. Each mechanical contractor shall be responsible for replacement/patching of all finish materials which have been disrupted and/or damaged as a result of their construction procedures. All materials shall match original and all work shall be done by experienced field tradesmen.
- D. Flushing, cleaning, and pressure testing of installed systems. Complete pressure test form.
- E. Cleanup associated with work of respective trades.
- F. Maintain records of changes to the drawings as they occur in the field and submit same to the Owner and/or Architect/Engineer as requested within 90 days after the date of system acceptance. See the General Conditions of this specification for additional information.

- G. Operation and Maintenance Manuals for all equipment provided, to be submitted prior to project close-out and final payment. Include at a minimum all information required by the 2013 Michigan Uniform Energy Code.
- H. All equipment furnished and installed shall comply with the relevant agency listing, testing, and labeling requirements of the 2021 Michigan Plumbing Code.
- I. No asbestos or mercury containing materials, materials capable of discharging lead into potable water or air systems, or materials capable of releasing other hazardous substances to the facility air environment, drainage systems, or water systems shall be used.
- J. Coordination with other trades. Contractor shall assist in the field layout and coordination of equipment, ductwork, and piping installation and their relation with other trades at no additional cost to the owner.
- K. Provide minimum two (2) year warranty against defects for materials and installation, unless otherwise indicated.
- L. Cost of State of Michigan Plumbing and Mechanical Permits.
- M. Cost to Authority Having Jurisdiction for water meter and strainer assembly.
- N. Job Site safety is the responsibility of the contractor. The architect/engineer bears no responsibility for job-site safety.
- O. Owner training in operation and maintenance of installed equipment and systems.
  - 1. Using the Operating and Maintenance manuals, balancing report data, and construction plans and specifications, contractor shall instruct owner's representatives in the proper operation of the equipment and systems installed to their mutual satisfaction. This activity shall take place near the point of substantial completion and will be considered one of the final punch list issues. Training shall consist of a period of "classroom" instruction providing a general overview of the facility equipment and systems plus a tour of the facility and its equipment pointing out specific maintenance issues for each area and item of equipment. When the training is complete owner shall be provided with a training certificate by the contractor by which the owner will acknowledge that such training has taken place.

## 1.2 STANDARDS, CODES AND PERMITS:

- A. Refer to Division 1, General Requirements and Supplementary Conditions.
- B. The Mechanical Contractor and his Subcontractors shall obtain all required permits and assessments prior to any work beginning. Contractor shall verify requirement to include privilege fees and permits as part of his formal bid.
- C. All work shall comply with the latest edition of applicable standards and codes of following:
  - 1. ASA American Standards Association
  - 2. ASME American Society of Mechanical Engineers
  - 3. ASTM American Society of Testing Materials

4. ANSI American National Standards Institute
5. AGA American Gas Association
6. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers 90.1-2013
7. AWWA American Water Works Association
8. NFPA National Fire Protection Association
9. IBR Institute of Boiler and Radiator Manufacturers
10. AWS American Welding Society
11. UL Underwriter s Laboratories
12. NEMA National Electric Manufacturers Association
13. NEC National Electric Code
14. ARA American Refrigeration Association
15. OSHA Occupational Safety and Health Act
16. MIOSHA Michigan Occupational Safety and Health Act
17. ABMA American Boiler Manufacturers Association
18. International Mechanical Code 2015
19. International Plumbing Code 2015

D. All work shall be provided and tested in accordance with all applicable local county, state laws, ordinances, codes, rules and regulations.

E. No work shall be covered or enclosed until the work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and submitted to Engineer before final acceptance of work.

### 1.3 SUBMITTALS:

#### A. Shop Drawings:

1. Submit electronic PDF copy of equipment and associated materials and equipment to Architect or Engineer for review.
2. Submit complete manufacturers shop drawings of all equipment, accessories and controls, including capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data.
3. Review of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under all Contract Documents and does not approve changes in time or cost.
4. Each Contractor is responsible to provide information to all other trades involved in or affected by installation of his equipment.

#### B. Operating and Maintenance Instruction and Manuals:

1. Each Contractor shall provide for all major items of equipment (3) bound and indexed sets of operating and maintenance instructions to Engineer for approval. Manual shall include a complete set of shop drawings.

## PART 2 - GENERAL

### 2.1 MATERIALS AND EQUIPMENT:

#### A. Proposal Supplement:

1. Contractor to submit a supplemental document which lists the Mechanical Equipment and Materials Manufacturers, and Subcontractors list with the bid document.
2. After Proposal Supplement and Subcontractors are approved, no deviation shall be permitted without written approval of Engineer or Owner.

#### B. Standards:

1. All products shall be furnished by established manufacturers regularly engaged in making the type of materials to be provided and complete with all parts, accessories, connections, etc. as specified or as recommended and/or required by the manufacturer.
2. All material where applicable shall be labeled or listed by Underwriters Laboratories, Inc.
3. Erect equipment in a neat and workmanlike manner. Align, level and adjust for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from arrangements may be made, as approved.

#### C. Base Bid

1. The Mechanical Contractor shall refer to the Mechanical Schedules and Specifications for approved equipment manufacturers. Contractor shall submit for Approved Equals during the bidding process.
2. Where base bid is not listed in specifications and if another manufacturer is listed as an approved equal, equipment from these manufacturers will be accepted contingent upon meeting the design, appearance, and functional standards established by the specified items.
3. The Contractor is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements and is responsible for advising other Contractors of variations and shall submit revised drawing layout for approval of Engineer.

#### D. Substitutions and Changes:

1. The Contractor shall bid the project in strict accordance with the Plans, Schedules, and Specifications. Alternative materials or methods proposed by the Mechanical Contractor shall be submitted in writing to the Engineer at least 5 Days Prior to the Bid due date and shall be preapproved for bidding. Failure to receive pre-approval will disqualify the Bid.
2. The Contractor is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design is used and is responsible for advising other Contractors of variations and, if requested, submit revised drawing layout for approval of Architect.

3. Work required by Engineer to revise drawings or re-engineer mechanical systems required by equipment substituted by the Contractor or them base bid shall be paid by the Contractor to the Engineer on a hourly rate basis.

## 2.2 ELECTRICAL REQUIREMENTS FOR PLUMBING WORK

### A. General:

1. When the Mechanical equipment not named as the basis of design is approved for use, the Mechanical Contractor is responsible for any costs incurred by other trades, including revisions to the Electrical requirements such as conduit, wire, starters, heaters, fused switches, disconnects, or circuit breakers.
2. Electrical items furnished shall bear the Underwriter s Laboratories label and the installation shall comply with requirements of the National Electric Code, ANSI, IPCEA, IRI, and local codes, ordinances and regulations.

### B. Motor Starters and Controls:

1. Unless specifically listed to be provided as an accessory to the equipment (such as roof top units, make-up air units, etc.), the Electrical Contractor shall provide all manual or magnetic motor starters as required for all motors as indicated on all Electrical Drawings.
2. Mechanical Contractor shall provide factory installed motor starters, disconnects, and convenience outlets where scheduled to be provided as an accessory to the unit. See equipment schedules.
3. The Mechanical Contractor, Temperature Control Contractor, Equipment Supplier, and Electrical Contractor are responsible to coordinate and ensure all electrical accessories are included as part of the Base Bid.

### C. Electrical Wiring and Controls:

1. Mechanical Contractor shall furnish and install all motors, drives, controllers integral to equipment and factory mounted controls for all mechanical equipment.
2. Mechanical Contractor or Temperature Control Contractor shall furnish and install all electrical devices requiring mechanical connections, and/or electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, motor operated dampers, fire stats, freeze stats, thermostats, override timers, E.P. s, P.E. s, temperature control cabinet, air compressor with starter, etc..
3. Electrical Contractor shall install all power wiring, conduit to motors and/or factory mounted control panels as indicated on Electrical Drawings or as indicated in Specifications.
4. All electrical wiring work by Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 26 requirements.

END OF SECTION

## SECTION 22 05 53

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Nameplates.
2. Tags.
3. Pipe markers.
4. Labels.

###### B. Related Sections:

1. See General Requirements - Painting and Coating: Execution requirements for painting specified by this section.

##### 1.2 REFERENCES

- A. ASME A13.1 - Scheme for the Identification of Piping Systems: The American Society of Mechanical Engineers; 2007.
- B. ASTM D 709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

##### 1.3 SUBMITTALS

- A. See General Requirements for Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

##### 1.4 CLOSEOUT SUBMITTALS

- A. See General Requirements for Execution and Closeout Requirements.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

## 1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

## 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

## 1.7 PRE-INSTALLATION MEETINGS

- A. See General Requirements for Administrative Requirements: Pre-installation meeting.
- B. Convene minimum two-weeks prior to commencing work of this section.

## 1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

## 1.9 EXTRA MATERIALS

- A. See General Requirements - Execution and Closeout Requirements: Spare parts and maintenance products.

## PART 2 - PRODUCTS

### 2.1 IDENTIFICATION APPLICATIONS

- A. Plumbing Equipment: Nameplates or Tags.
- B. Plumbing and Hydronic Piping: Plastic Pipe Markers.
- C. Pumps: Nameplates.

### 2.2 NAMEPLATES

- A. Manufacturers:
  - 1. Advanced Graphic Engraving: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com).
  - 2. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
  - 3. Seton Identification Products: [www.seton.com](http://www.seton.com).
  - 4. Or Approved Equal.
- B. Product Description: Laminated three-layer plastic with engraved letters on light contrasting background color.

1. Letter Color: White.
2. Letter Height: 1/2 inch (12 mm).
3. Background Color: Black.
4. Plastic: Conform to ASTM D 709

## 2.3 TAGS

### A. Plastic Tags

1. Manufacturers:
  - a. Advanced Graphic Engraving: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com).
  - b. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
  - c. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
  - d. Seton Identification Products: [www.seton.com](http://www.seton.com).
  - e. Or Approved Equal.
2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

### B. Metal Tags

1. Manufacturers:
  - a. Advanced Graphic Engraving: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com).
  - b. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
  - c. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
  - d. Seton Identification Products: [www.seton.com](http://www.seton.com).
  - e. Or Approved Equal.
2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

## 2.4 PIPE MARKERS and PIPE STICKERS

### A. Color and Lettering: Conform to ASME A13.1.

### B. Plastic Pipe Markers (Applied to insulated and wrapped piping).

1. Plastic Pipe Markers: Factory fabricated, wrap-around, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
2. Size (including insulation) Pipe O.D. (inches) = Letter Size (inches):
  - a. 0.75" – 1" = 1/2" Letters.
  - b. 1.25" – 2.375" = 3/4" Letters.
  - c. 2.5" – 7.875" = 1.25" Letters.
  - d. 8" – 9.875" = 2.5" Letters.
  - e. 10" and larger = 3.5" Letters.

### C. Plastic Tape Pipe Markers (Applied to painted uninsulated or wrapped piping).



1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
2. Size (including insulation) Pipe O.D. (inches) = Letter Size (inches):
  - a. 0.75" = 1/2" Letters.
  - b. 1" – 2.5" = 3/4" Letters.
  - c. 2.5" – 7.875" = 1.25" Letters.
  - d. 8" – 9.875" = 2.5" Letters.
  - e. 10" and larger = 3.5" Letters.

## 2.5 UNDERGROUND WARNING TAPE

### A. Underground Warning Tape

#### 1. Manufacturers:

- a. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- b. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
- c. Seton Identification Products: [www.seton.com](http://www.seton.com).
- d. Or Approved Equal.

### B. Description: Polyethylene tape with metallic core for detection and location of piping with metal detector resistant to acids, alkalis and other soil components.

1. Size: 0.004 inch6 inches
2. Printed text as selected by Architect/Engineer in contrasting color and repeated at maximum 36 inches intervals.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- #### A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- #### A. Install identifying devices after completion of coverings and painting.
- #### B. Install plastic nameplates on all plumbing equipment. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- #### C. Install with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- #### D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- #### E. Install wrap-around pipe markers on all insulated and wrapped plumbing piping including: Storm, Sanitary, CW, HW, DHWR (recirculation), Tempered Water, and condensate. Include flow

direction arrows on recirculation piping (at least one flow direction arrow next to label in each room).

- F. Install adhesive pipe markers on all painted (uninsulated) piping located indoors including: Natural Gas, and Sanitary vent (not installed within walls). For indoor exposed natural gas lines, attach yellow pipe labels with "GAS" in black lettering, at maximum 5 foot spacing.
- G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- H. Identify valves in main and branch piping with tags.

END OF SECTION

SECTION 22 63 00  
NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This Section includes piping, specialties, and accessories for natural gas systems downstream of the gas meter.
2. Gas service is not part of the work of this Division.

- B. Gas Service by Consumers Energy: Pipe from gas main or other source to gas point of delivery for building being served. Piping includes gas service piping, gas valve, service pressure regulator, meter bar or meter support, and gas meter.

1.2 SUBMITTALS

- A. Product Data: Piping and valves.

- B. Field Quality-Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 54, "National Fuel Gas Code," for gas piping materials and components; installations; and inspecting, testing, and purging. Comply with applicable parts of NFPA 58.

- B. Comply with NFPA 70, "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

- C. Comply with 2015 International Fuel Gas Code.

- D. Manufacturer: Company specializing in manufacturing products specified in this Section with ten years' experience.

- E. Fabricator: Company specializing in fabricating products specified in this Section with ten years' experience.

- F. Installer: Company specializing in performing Work of this Section with five years' of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store according to manufacturer's instructions.

- B. Protect piping and fittings from water, moisture, corrosion and rust.

## 1.5 WARRANTY

- A. Furnish two-year contractor warranty for all labor.

## 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. Gas Stops, 2-Inch NPS (DN50) and Smaller.
    - a. Hammond Valve Corp.
    - b. Jomar International, Ltd.
    - c. Maxitrol Co.
    - d. McDonald: A.Y. McDonald Mfg. Co.
    - e. Milwaukee Valve Co., Inc.
    - f. Mueller Co.
    - g. National Meter
    - h. Or Approved Equals.
  - 2. Gas Valves, 2-Inch NPS (DN50) and Smaller:
    - a. Conbraco Industries, Inc.; Apollo Div.
    - b. Core Industries, Inc.; Mueller Steam Specialty Div.
    - c. Huber: J.M. Huber Corp.; Flow Control Div.
    - d. McDonald: A.Y. McDonald Mfg. Co.
    - e. Milliken Valve Co., Inc.
    - f. Milwaukee Valve Co., Inc.
    - g. Mueller Co.
    - h. National Meter.
    - i. Nordstrom Valves, Inc.
    - j. Olson Technologies, Inc.
    - k. Or Approved Equals.
  - 3. Gas Valves, 2-1/2-Inch NPS (DN65) and Larger:
    - a. Core Industries, Inc.; Mueller Steam Specialty Div.
    - b. Huber: J.M. Huber Corp.; Flow Control Div.
    - c. Milliken Valve Co., Inc.
    - d. Nordstrom Valves, Inc.
    - e. Olson Technologies, Inc.
    - f. Xomox Corp.
    - g. Or Approved Equals.

### 2.2 MATERIALS

- A. Above Ground Pipes and Tubes.
  - 1. Steel Pipe: ASTM A 53; Type E, electric-resistance welded or Type S, seamless; Grade B; Schedule 40; black.

2. Copper tubing: ASTM B-88, Type K, annealed with wrought fittings.

B. Below Ground Pipes and Tubes.

1. LPG pipe equal to Oil Creek Plastics PE-2708 & PE-4710.
2. Conform to ASTM D 2513.
3. Tracer wire for future locating.

C. Pipe and Tube Fittings.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends conforming to ASME B1.20.1.
2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends conforming to ASME B1.20.1.
3. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250.
4. Steel Fittings: ASME B16.9, wrought steel, butt-welding type; and ASME B16.11, forged steel.
5. Steel Flanges and Flanged Fittings: ASME B16.5.
6. Copper Fittings: ASME B16.22, wrought copper, streamlined pattern.

D. Joining Materials

1. Joint Compound and Tape: Suitable for natural gas.
2. Gasket Material: Thickness, material, and type suitable for natural gas.

E. Valves

1. Manual Valves: Conform to standards listed or, where appropriate, to ANSI Z21.15.
2. Gas Valves, 2-Inch NPS (DN50) and Smaller: ASME B16.33, 150 psig (1035 kPa) WOG, bronze body, bronze plug, straightaway pattern, square head, tapered-plug type, with threaded ends conforming to ASME B1.20.1.
3. Locking Device: Lockable in closed position.
4. Gas Valves, 2-1/2-Inch NPS (DN65) and Larger: MSS SP-78, Class 175 WOG, lubricated-plug type, semisteel body, wrench operated, with flanged ends. Lockable in closed position.

## 2.3 FINISHES

A. Paint all interior and exterior natural gas piping using high gloss safety yellow interior/exterior oil-based paint. Rustoleum Professional High Performance Protective Enamel, 242258 Safety Yellow. Or Approved Equal.

B. If a painting contractor is not part of the general trades subcontract the Plumbing Contractor must subcontract a licensed Painting Contractor to perform the application of all painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify all piping is free of grease, rust, and corrosion.

### 3.2 PREPARATION

- A. Close equipment shutoff valves before turning off gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.
- B. Comply with NFPA 54 Paragraph "Prevention of Accidental Ignition."

### 3.3 SERVICE ENTRANCE PIPING

- A. Install shutoff valve, downstream from gas meter, outside building at gas service entrance.

### 3.4 PIPING APPLICATIONS

- A. General: Flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating may be used in applications below, except where otherwise indicated.
  - 1. 1-Inch NPS (DN25) and Smaller: Steel pipe, malleable-iron threaded fittings, and threaded joints.
  - 2. 1-1/4- to 2-Inch NPS (DN32 to DN50): Steel pipe, malleable-iron threaded fittings, and threaded joints.
  - 3. 2-1/2- to 4-Inch NPS (DN65 to DN100): Steel pipe, butt-welding fittings, and welded joints.

### 3.5 VALVE APPLICATIONS

- A. Use gas stops for shutoff to appliances with 2-inch NPS (DN50) or smaller low-pressure gas supply.

### 3.6 PIPING INSTALLATIONS

- A. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe or Schedule 40, PVC DWV pipe with welded joints. Vent conduit to outside and terminate with screened vent cap. Install as detailed on drawings.
  - 1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves in such spaces.
  - 2. In Walls: Gas piping with welded joints and protective wrapping specified in "Protective Coating" Article in Part 2 may be installed in masonry walls, subject to approval of authorities having jurisdiction.
  - 3. In Vertical Pipe Chases: Chases shall not continue above ceilings.
  - 4. Prohibited Locations: Do not install gas piping in walls or under floors.
    - a. Exception: Accessible above-ceiling space specified above.
    - b. Exception: Tubing passing through partitions or walls.
    - c. Exception: In vented sleeve as indicated above and on the drawings.
- B. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of gas meters. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches (75 mm) long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- C. Install gas piping at uniform grade of 0.1 percent slope upward toward risers.
  - D. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
  - E. Connect branch piping from top or side of horizontal piping.
  - F. Install unions in pipes 2-inch NPS (DN50) and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
  - G. Install dielectric fittings (unions and flanges) with ferrous and brass or bronze end connections, separated by insulating material, where piping of dissimilar metals is joined.
  - H. Install dielectric fittings (unions and flanges) with 2 ferrous end connections, separated by insulating material, at outlet from gas meter.
  - I. Install flanges on valves, specialties, and equipment having 2-1/2-inch NPS (DN65) and larger connections.
  - J. Anchor piping to ensure proper direction of piping expansion and contraction. Install expansion joints, expansion loops, and pipe guides as indicated.
  - K. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
  - L. Where elevated gas pressure greater than 7" water column, install pressure reducing valves per manufacturer installation instructions, and vent to atmosphere as needed.

### 3.7 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Use materials suitable for natural gas service.

### 3.8 VALVE INSTALLATION

- A. Install valves in accessible locations, protected from damage. Tag valves with metal tag indicating piping supplied. Attach tag to valve with metal chain.
  1. Refer to Division 22 & 23 Section "Mechanical Identification" for valve tags.

- B. Install gas valve upstream from each gas pressure regulator. Where 2 gas pressure regulators are installed in series, valve is not required at second regulator.
- C. Install pressure relief or pressure-limiting devices so they can be readily operated to determine if valve is free; test to determine pressure at which they will operate; and examine for leakage when in closed position.

### 3.9 HANGER SUPPORT AND INSTALLATION

- A. Gas piping to be supported with Eaton Dura-Blok supports or equal.
- B. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices.
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  1. 1/2-Inch NPS (DN15): Maximum span, 72 inches (1829 mm); minimum rod size, 3/8 inch (10 mm).
  2. 3/4- and 1-Inch NPS (DN20 and DN25): Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
  3. 1-1/4-Inch NPS (DN32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
  4. 1-1/2- and 2-Inch NPS (DN40 and DN50): Maximum span, 108 inches (2473 mm); minimum rod size, 3/8 inch (10 mm).
  5. 2-1/2- to 3-1/2-Inch NPS (DN65 to DN90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).

### 3.10 CONNECTIONS

- A. Connect gas piping to equipment and appliances using gas with shutoff valves and unions. Install gas valve upstream from and within 72 inches (1800 mm) of each appliance using gas. Install union or flanged connection downstream from valve. Include flexible connectors when indicated.
- B. Sediment Traps: Install tee fitting with capped nipple in bottom forming drip, as close as practical to inlet for appliance using gas.

### 3.11 ELECTRICAL BONDING AND GROUNDING

- A. Install aboveground portions of natural gas piping systems that are upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.
- B. Do not use gas piping as grounding electrode.

### 3.12 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to NFPA 54, Part 4 "Gas Piping Inspection, Testing, and Purging" and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.



- C. Verify capacities and pressure ratings of gas meters, regulators, valves, and specialties.
- D. Verify correct pressure settings for pressure regulators.
- E. Verify that specified piping tests are complete.

### 3.13 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

### 3.14 CLEANING

- A. Clean piping free of oil and grime prior to applying protective safety paint.

END OF SECTION

## SECTION 23 00 00

### HVAC

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Division includes all materials, labor, equipment, tools, supervision, permits, and incidentals necessary to complete installation, test, start up, and operate in a practical and efficient manner all Mechanical Systems indicated on the Drawings and described in this Division. The work shall also include any items which, while not specifically included in the Contract Documents but are reasonable and are accepted trade practices or necessary for the proper completion of the systems.
- B. Mechanical systems in the Contract shall include the following: HVAC systems including all equipment, temperature controls, ductwork, piping, and insulation indicated on the drawings and the specifications.
- C. The General Provisions of this Contract, including General and Supplementary Conditions and other General Requirements Sections, apply to the Work specified in this Section.
- D. This Section is not intended to supersede, but to clarify the definitions in Division 1, General Requirements and Supplementary Conditions.
- E. Drawings and Specifications
  - 1. Drawings and Specifications are intended to supplement each other, and all work specified or indicated in either shall be provided.
  - 2. Drawings are diagrammatic and indicate general arrangement of work included in the Contract and shall serve only as design drawings and not as working drawings, for general layout of various equipment and systems. Should drawings disagree in themselves or with Specifications, the better quality or greater quantity of work shall be provided.
  - 3. Separate specifications over the other trades. The Mechanical Contractor shall familiarize himself with these other specifications.
  - 4. Should there be any question as to the scope of work for which the Mechanical Contractor is responsible, he shall request an interpretation before submitting his bid. After contracts are awarded, the Owner will not consider claims for extras because of the incomplete joining of the work of one contractor (or subcontractor) with another.

##### 1.2 COORDINATION OF MECHANICAL WORK

- A. Responsibility
  - 1. The Mechanical Contractor shall be responsible for all Subcontractors and Suppliers, and include in his bid all materials, labor and equipment involved in accordance with all local regulations, jurisdictional awards, and decisions and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.
  - 2. The Mechanical Contractor and Subcontractor shall be responsible for all parts applicable to his trade in accordance with the Specifications and Drawings, and shall be responsible for

coordinating locations and arrangements of his work with all other relevant Architectural, Structural and Electrical Contractor's Specifications, Drawings and Shop Drawings

B. Site and Project Document Examination:

1. Submission of a Bid Proposal is considered evidence that the Contractor has visited the site, examined the Drawing and Specifications of all trades and has fully informed himself as to project and site conditions and is proficient, experienced and knowledgeable of all state, local and federal standards, codes, ordinances, permits, and regulations which affect every Subcontractors completion, cost and time required and that all costs are included in his Bid Proposal.

C. General Supports:

1. Mechanical Contractor shall provide all necessary channel, angle, brackets or supplementary steel as required for adequate support for all piping, specialties, and equipment, which is hung or mounted above floor, and secure approval from Architect or Engineer, in writing, before welding or bolting to steel framing or anchoring to concrete structure.
2. Where piping or equipment is suspended from concrete construction, set approved concrete inserts in formwork to receive hanger rods, such as Unistrut and where installed in metal deck use Ramset or Welds as required.

D. Wall, Floor and Ceiling Openings:

1. Locate all openings and advise the General Contractor of details and templates of all openings necessary for inspection of mechanical work.
2. In general, openings and required lintels shall be provided by the General Contractor. Size and location is the responsibility of the Mechanical Contractor. Cracks and rough edges left following installation of equipment shall be caulked or covered by the Mechanical Contractor.

E. Field Changes:

1. This Contractor shall not make any field changes that effect timing, costs or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order or a Supplemental Instruction. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any unauthorized change be determined by the Architect as lessening the value of the project, a credit will be determined and issued as a change to the Contract.

1.3 STANDARDS, CODES AND PERMITS:

A. Refer to Division 1, General Requirements and Supplementary Conditions.

B. The Mechanical Contractor and his Subcontractors shall obtain all required permits and assessments prior to any work beginning. Contractor shall verify requirement to include privilege fees and permits as part of his formal bid.

C. All work shall comply with the latest edition of applicable standards and codes of following:

1. ASA American Standards Association
2. ASME American Society of Mechanical Engineers
3. ASTM American Society of Testing Materials
4. ANSI American National Standards Institute

5. AGA American Gas Association
6. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
7. AWWA American Water Works Association
8. NFPA National Fire Protection Association
9. IBR Institute of Boiler and Radiator Manufacturers
10. AWS American Welding Society
11. UL Underwriter s Laboratories
12. NEMA National Electric Manufacturers Association
13. NEC National Electric Code
14. ARA American Refrigeration Association
15. OSHA Occupational Safety and Health Act
16. MIOSHA Michigan Occupational Safety and Health Act
17. ABMA American Boiler Manufacturers Association
18. International Mechanical Code 2015
19. International Plumbing Code 2015

- D. All work shall be provided and tested in accordance with all applicable local county, state laws, ordinances, codes, rules and regulations.
- E. No work shall be covered or enclosed until the work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and submitted to Engineer before final acceptance of work.

#### 1.4 SUBMITTALS:

- A. Shop Drawings:
1. Submit electronic PDF copy of equipment and associated materials and equipment to Architect or Engineer for review.
  2. Submit complete manufacturers shop drawings of all equipment, accessories and controls, including capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data.
  3. Review of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under all Contract Documents and does not approve changes in time or cost.
  4. Each Contractor is responsible to provide information to all other trades involved in or affected by installation of his equipment.
- B. Operating and Maintenance Instruction and Manuals:
1. Each Contractor shall provide for all major items of equipment (3) bound and indexed sets of operating and maintenance instructions to Engineer for approval. Manual shall include a complete set of shop drawings.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT:

- A. Proposal Supplement:

1. Contractor to submit a supplemental document which lists the Mechanical Equipment and Materials Manufacturers, and Subcontractors list with the bid document.
2. After Proposal Supplement and Subcontractors are approved, no deviation shall be permitted without written approval of Engineer or Owner.

B. Standards:

1. All products shall be furnished by established manufacturers regularly engaged in making the type of materials to be provided and complete with all parts, accessories, connections, etc. as specified or as recommended and/or required by the manufacturer.
2. All material where applicable shall be labeled or listed by Underwriters Laboratories, Inc.
3. Erect equipment in a neat and workmanlike manner. Align, level and adjust for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from arrangements may be made, as approved.

C. Base Bid:

1. The Mechanical Contractor shall refer to the Mechanical Schedules and Specifications for approved equipment manufacturers. Contractor shall submit for Approved Equals during the bidding process.
2. Where base bid is not listed in specifications and if another manufacturer is listed as an approved equal, equipment from these manufacturers will be accepted contingent upon meeting the design, appearance, and functional standards established by the specified items.
3. The Contractor is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements and is responsible for advising other Contractors of variations and shall submit revised drawing layout for approval of Engineer.

D. Substitutions and Changes:

1. The Contractor shall bid the project in strict accordance with the Plans, Schedules, and Specifications. Alternative materials or methods proposed by the Mechanical Contractor shall be submitted in writing to the Engineer at least 3 Days Prior to the Bid due date and shall be preapproved for bidding. Failure to receive pre-approval will disqualify the Bid.
2. The Contractor is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design is used and is responsible for advising other Contractors of variations and, if requested, submit revised drawing layout for approval of Architect.
3. Work required by Engineer to revise drawings or re-engineer mechanical systems required by equipment substituted by the Contractor or them base bid shall be paid by the Contractor to the Engineer on a hourly rate basis.

## 2.2 ELECTRICAL REQUIREMENTS FOR MECHANICAL WORK

A. General:

1. When the Mechanical equipment not named as the basis of design is approved for use, the Mechanical Contractor is responsible for any costs incurred by other trades, including revisions to the Electrical requirements such as conduit, wire, starters, heaters, fused switches, disconnects, or circuit breakers.

2. Electrical items furnished shall bear the Underwriter s Laboratories label and the installation shall comply with requirements of the National Electric Code, ANSI, IPCEA, IRI, and local codes, ordinances and regulations.

B. Motor Starters and Controls:

1. Unless specifically listed to be provided as an accessory to the equipment (such as roof top units, make-up air units, etc.), the Electrical Contractor shall provide all manual or magnetic motor starters as required for all motors as indicated on all Electrical Drawings.
2. Mechanical Contractor shall provide factory installed motor starters, disconnects, and convenience outlets where scheduled to be provided as an accessory to the unit. See equipment schedules.
3. The Mechanical Contractor shall provide variable frequency drives (VFDs) where scheduled to be provided as an accessory to the unit unless otherwise specified or if coordinated with the Electrical Contractor.
4. The Mechanical Contractor, Temperature Control Contractor, Equipment Supplier, and Electrical Contractor are responsible to coordinate and ensure all electrical accessories are included as part of the Base Bid.

C. Electrical Wiring and Controls:

1. Mechanical Contractor shall furnish and install all motors, drives, controllers integral to equipment and factory mounted controls for all mechanical equipment.
2. Mechanical Contractor or Temperature Control Contractor shall furnish and install all electrical devices requiring mechanical connections, and/or electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, motor operated dampers, fire stats, freeze stats, thermostats, override timers, E.P. s, P.E. s, temperature control cabinet, air compressor with starter, etc.
3. Temperature Control Contractor or Mechanical Contractor shall furnish and install all power and Class 2 and 3 wiring, conduit boxes for their associated equipment in 2.02, C, 2.
4. Electrical Contractor shall install all power wiring, conduit to motors and/or factory mounted control panels as indicated on Electrical Drawings or as indicated in Specifications.
5. All electrical wiring work by Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 26 requirements.

D. See also, Division 26, Electrical Requirements for Mechanical Equipment.

END OF SECTION

## SECTION 23 05 29

### HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping and accessories for HVAC Work.
10. Equipment bases and supports.

###### B. Related Requirements:

1. Section 03 10 00 - Concrete Forming and Accessories: Placement of [inserts] [sleeves] in concrete forms as required by this Section.
2. Section 03 30 00 - Cast-in-Place Concrete: Placement of concrete housekeeping pads as required by this Section.
3. Section 07 84 00 - Firestopping: Firestopping for placement by this Section.
4. Section 07 90 00 - Joint Protection: Sealant materials for placement by this Section.
5. Section 09 90 00 - Painting and Coating: Painting as required by this Section.
6. Section 09 96 35 - Chemical-Resistant Coatings: Painting as required by this Section in designated areas subject to chemical corrosion.
7. Section 21 05 48 - Vibration and Seismic Controls for Fire-Suppression Piping and Equipment: Coordination with installation of rigid pipe anchors.
8. Section 22 07 00 - Plumbing Insulation: Piping and accessory insulation as required by this Section.

##### 1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

###### A. Concrete Work:

1. Basis of Measurement: Included in other pay items for this project.
2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

1.3 MSS STANDARD COMPLIANCE: Comply with the following:

- A. Provide pipe hangers and supports on which materials, design, and manufacture comply with MSS SP-58.
- B. Select and apply pipe hangers and supports, complying with MSS SP-69.
- C. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
- D. Terminology used in this section is defined in MSS SP-90. ABOVE STANDARDS ARE AVAILABLE FROM MSS (MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC.).
- E. Regulatory Requirements: Comply with appliance plumbing codes pertaining to product materials and installation of supports and anchors.
- F. NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system.
- G. UL and FM Compliance: Hangers, supports, and components shall be listed and labeled by UL and FM where used for fire protection piping systems.
- H. Submittals: Submit manufacturer's technical product data, including installation instructions; shop drawings; and maintenance data for each type of support and anchor

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): The material used to seal or stuff or an assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.

1.5 REFERENCE STANDARDS

A. American Welding Society:

- 1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

B. ASME International:

- 1. ASME B31.1 - Power Piping.
- 2. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- 3. ASME B31.9 - Building Services Piping.

C. ASTM International:

- 1. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- 2. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- 3. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.



- D. FM Global:
  - 1. FM - Approval Guide.
- E. Intertek Testing Services (Warnock Hersey Mark):
  - 1. WH-ETL - Product Directory.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
  - 1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- G. UL:
  - 1. UL - Fire-resistance-rated Systems and Products.
  - 2. UL 263 - Fire Tests of Building Construction and Materials.
  - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
  - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

#### 1.6 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

#### 1.7 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
  - 1. Hangers and Supports: Submit manufacturer's catalog information, including load capacity.
  - 2. Firestopping: Submit information on product characteristics, performance, and limitations.
- C. Shop Drawings:
  - 1. Indicate system layout with location, including critical dimensions and sizes.
  - 2. Indicate pipe hanger and support locations, and detail of trapeze hangers.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrated items, and specified design numbers to seal openings to maintain fire-resistance rating of adjacent assembly.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Delegated Design Submittals:
  - 1. Submit signed and sealed Shop Drawings with design calculations and assumptions for load-carrying capacity of trapeze, multiple-pipe, and riser support hangers.

2. Submit sizing methods and calculations sealed by a registered professional engineer (P.E.).
3. Firestopping Engineering Judgments: For conditions not covered by UL or WH-ETL listed designs, submit judgments by licensed P.E. suitable for presentation to authority having jurisdiction for acceptance as meeting fire protection code requirements.

G. Manufacturer Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

I. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.
3. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.

## 1.8 QUALITY ASSURANCE

A. Through-Penetration Firestopping of Fire-Rated Assemblies:

1. Comply with UL 1479 and ASTM E814.
2. Positive Pressure Differential:
  - a. As required to achieve fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
  - b. Minimum 0.10 inch wg.
3. Wall Penetrations: Fire F-ratings as indicated on Drawings, but not less than one hour.
4. Floor and Roof Penetrations:
  - a. Fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
  - b. Floor Penetrations within Wall Cavities: T-rating not required.

B. Through-Penetration Firestopping of Non-fire-rated Floor and Roof Assemblies:

1. Materials: Resist free passage of flame and products of combustion.
2. Noncombustible Penetrating Items: Connecting maximum three stories.
3. Penetrating Items: Materials approved by authorities having jurisdiction for connecting maximum two stories.

C. Fire-Resistive Joints in Fire-Rated Floor, Roof, and Wall Assemblies:

1. Comply with ASTM E1966 and UL 2079.
2. As required to achieve fire-resistance rating as indicated on Drawings for assembly in which joint is installed.

D. Fire-Resistive Joints between Floor Slabs and Exterior Walls:

1. Comply with ASTM E119.
2. Positive Pressure Differential:
  - a. As required to achieve fire F-ratings and temperature T-ratings as indicated on Drawings for floor assembly.
  - b. Minimum 0.10 inch wg.

E. Surface-Burning Characteristics:

1. Maximum 25/450 flame-spread/smoke-developed index.
2. Testing: Comply with ASTM E84.

F. Welding of Hanger and Support Attachments to Building Structure: Comply with applicable authority and AWS D1.1/D1.1M.

G. Perform Work according to <\_\_\_\_\_> standards.

H. Maintain 2 copies of each standard affecting Work of this Section on Site.

## 1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.

C. Welders: AWS qualified within previous 12 months for employed weld types.

## 1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

### 1.11 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Minimum Conditions:
  - 1. Do not apply firestopping materials if temperature of substrate material and ambient air is below 60 degrees F.
  - 2. Maintain this minimum temperature before, during, and for minimum three days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

### 1.12 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

### 1.13 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for pipe hangers and supports.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Except as otherwise indicated, provide factory-fabricated pipe hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
- B. Horizontal-Piping Hangers and Supports:
- C. Adjustable Steel Clevis Hangers: MSS Type 1.
- D. Adjustable Steel Band Hangers: MSS Type 7.
- E. Adjustable Band Hangers: MSS Type 9.
- F. Adjustable Swivel Rings, Band Type: MSS Type 10.

## 2.2 VERTICAL-PIPING CLAMPS:

- A. Two-Bolt Riser Clamps: MSS Type 8.
- B. Four-Bolt Riser Clamps: MSS Type 42.

## 2.3 HANGER-ROD ATTACHMENTS:

- A. Steel Turnbuckles: MSS Type 13.
- B. Steel Clevises: MSS Type 14.
- C. Swivel Turnbuckles: MSS Type 15.
- D. Malleable Iron Sockets: MSS Type 16.
- E. Steel Weldless Eye Nuts: MSS Type 17.

## 2.4 BUILDING ATTACHMENTS:

- A. Concrete Inserts: MSS Type 18.
- B. Top Beam C-Clamps: MSS Type 19.
- C. Side Beam or Channel Clamps: MSS Type 20.
- D. Center Beam Clamps: MSS Type 21.
- E. Welded Beam Attachments: MSS Type 22.
- F. C-Clamps: MSS Type 23.
- G. Top Beam Clamps: MSS Type 25.
- H. Side Beam Clamps: MSS Type 27.
- I. Steel Beam Clamps W/Eye Nut: MSS Type 28.
- J. Linked Steel Clamps W/Eye Nut: MSS Type 29.
- K. Malleable Beam Clamps: MSS Type 30.

## 2.5 MANUFACTURERS OF HANGERS AND SUPPORTS

- A. B-Line Systems
  - 1. Carpenter and Patterson; Corner & Lada; Elcen Metal Products; Fee & Mason; or ITT Grinnel or Approved Equal.
- B. Pipe Guides

1. Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
- C. Pipe Curb Assembly
1. Pipe curb assembly shall be Pate pca, or equal, 18 gauge galvanized steel, unitized construction with integral base plate insulated with 3 @ density insulation, 2 x 3 nailer, acrylic clad ABS plastic cover, fastening screws, graduated step boots with stainless steel clamps.
- D. Multiple Pipe Curb Assembly
1. Heavy gauge galvanized steel, unitized, full mitered corners, all seams welded, 1-1/2" thick rigid fiberboard insulation, 2 x 4 wood nailer strip, acrylic lad ABS plastic covers, PVC boots and stainless steel clamps.
- E. Rooftop Equipment Support Curbs or Rails
1. Furnish where shown or required. Equal to Pate Model ES-5A, minimum 14" high. Curbs shall be designed to support the equipment it supports on the structure as shown on plans.
- F. Specification for Pipe Pier Roof Pipe Supports
1. Piping on roof surfaces may be supported by a polyethylene foam block with an integral strut cannal for receiving standard strut clamps and accessories. Pipe Pier shall be installed according to manufacturer's recommendations. Roof pipe supports shall be spaced according to industry standards and shall be installed to allow for expansion and contraction. Acceptable Manufacturer: Erico.
- G. Gas Piping on Grade or Roof Membrane
1. Eaton Dura-Blok rooftop supports or equal.

## 2.6 DESCRIPTION

- A. Firestopping Materials: As specified in Section 07 84 00 – Firestopping or as described below.
- B. Firestopping Materials:
1. Comply with ASTM E119, ASTM E814, UL 263, and UL 1479.
  2. Adjacent Construction:
    - a. Achieve fire ratings as indicated on Drawings for adjacent construction.
    - b. Minimum Fire Rating: 3 hours.
- C. Firestopping Materials:
1. Comply with ASTM E119, ASTM E814, UL 263, and UL 1479.
  2. Adjacent Construction:
    - a. Achieve fire ratings according to indicated applicable FM, UL, and WH-ETL Design Numbers.
- D. Firestop interruptions to fire-rated assemblies, materials, and components.

## 2.7 PERFORMANCE AND DESIGN CRITERIA

- A. Firestopping Materials: As specified in Section 07 84 00 – Firestopping or complying with the following:
- B. Firestopping:
  - 1. Comply with applicable code FM, UL, and WH-ETL for fire-resistance ratings and surface-burning characteristics.
  - 2. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

## 2.8 FIRESTOPPING

- A. Firestopping Materials: As specified in Section 07 84 00 – Firestopping and/or as described below.
- B. Manufacturers:
  - 1. Hilti USA.
  - 2. 3M.
  - 3. Or Approved Equals

Furnish materials according to NFPA standards.

- C. Description:
  - 1. Various types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements.
  - 2. Provide only one type for each similar application.
  - 3. Silicone Elastomeric Firestopping: Single or Multiple-component silicone elastomeric compound and compatible silicone sealant.
  - 4. Foam Firestopping Compounds: Single or Multiple-component foam compound.
  - 5. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
  - 6. Fiber Stuffing and Sealant Firestopping: Composite of mineral-fiber stuffing insulation with silicone elastomer for smoke stopping.
  - 7. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless-steel jacket, joined with collars, and penetration sealed with flanged stops.
  - 8. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
  - 9. Firestop Pillows: Formed mineral-fiber pillows.
- D. Color: Dark gray or as selected from manufacturer's full range of colors.

## 2.9 FIRESTOPPING ACCESSORIES

- A. Installation Accessories: As specified in Section 07 84 00 – Firestopping and/or as described below.

- B. Primer: Type as recommended by firestopping manufacturer for specific substrate surfaces and as suitable for required fire ratings.
- C. Permanent Dam Material:
  - 1. Mineral fiberboard.
  - 2. Mineral fiber matting.
  - 3. Sheet metal.
  - 4. Plywood or particle board.
  - 5. Alumina silicate board.
  - 6. As approved by NFPA and AHJ.
- D. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- E. General:
  - 1. Furnish UL-listed products.
  - 2. Select products with rating not less than rating of wall or floor being penetrated.
- F. Nonrated Surfaces:
  - 1. Covering for Openings in Occupied Areas Where Piping is Exposed: Stamped-steel, chrome-plated, hinged, split-ring escutcheons, or floor or ceiling plates.
  - 2. Exterior Wall Openings below Grade: Furnish mechanical sealing device to continuously fill annular space between piping and cored opening or waterstop-type wall sleeve.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that openings are ready to receive sleeves.
- C. Verify that openings are ready to receive firestopping.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that may affect bond of firestopping material.
- C. Remove incompatible materials that may affect bond.



- D. Install backing or damming materials to arrest liquid material leakage.
- E. Do not drill or cut structural members.

### 3.3 INSTALLATION

#### A. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
4. If concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. If inserts are omitted, drill through concrete slab and coordinate with Structural Engineer.
6. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.
7. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
8. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
9. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
10. Field-Fabricated, Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.
11. Support fire protection systems piping independently from other piping systems.
12. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
13. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes.
14. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units. Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
15. Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
16. Comply with the following installation requirements for insulated piping:

- a. Clamps: Attach clamps, including spacers (if any), to piping with clamps protecting through insulation; do not exceed pipe stresses allowed by ANSI B31. Do not use wall mounted clamps to support exposed piping.
  - b. Shields: Install protective shields MSS Type 40 on cold water piping that has vapor barrier. Shield shall span an arc of 180 degrees.
17. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
  18. Install anchors where not otherwise indicated, at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.
  19. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
  20. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
  21. Installation of pipe curb assemblies and pipe seals and rooftop equipment curb or rails: Install in strict accordance with manufacturer's written instructions.

B. Pipe Hangers and Supports:

1. Comply with ASME B31.1.
2. Comply with ASTM F708 and MSS SP-58.
3. Support horizontal piping as scheduled per 2015 Michigan Mechanical Code.
4. Minimum Hanger Spacing: 1/2 inch between finished covering and adjacent Work.
5. Place hangers within 12 inches of each horizontal elbow.
6. Minimum Vertical Hanger Adjustment: 1-1/2 inches.
7. Support vertical piping at every floor.
8. If piping is installed in parallel and at same elevation, provide multiple-pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Design hangers for pipe movement without disengagement of supported pipe.
11. Painting and Coating:
  - a. Chemical resistant coatings are required for all hangers and supports in process and chlorine rooms.
  - b. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
12. Insulation:
  - a. Provide clearance in hangers and from structure and other equipment for installation of insulation.
  - b. As specified in Section 22 07 00 - Plumbing Insulation and 23 07 00 HVAC Insulation.

C. Sleeves:

1. Exterior Watertight Entries: Seal with mechanical sleeve seals.
2. Set sleeves in position in forms and provide reinforcing around sleeves.
3. Sizing:
  - a. Size sleeves large enough to allow for movement due to expansion and contraction.

- b. Provide for continuous insulation wrapping.
- 4. Extend sleeves through floors [1 inch] [<\_\_\_\_\_> inches] above finished floor level, and calk sleeves.
- 5. Spaces:
  - a. If piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent Work with firestopping insulation and/or calk water and weathertight.
  - b. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.
  - c. Install chrome-plated steel escutcheons at finished surfaces of plumbing piping in bathrooms and kitchens.

D. Firestopping:

- 1. Firestopping Materials: As specified in Section 07 84 00 - Firestopping.
- 2. Install material at fire-rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items requiring firestopping.
- 3. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- 4. Apply firestopping material [**to uniform density and texture and**] in sufficient thickness to achieve required fire and smoke rating.
- 5. Placement: Compress fibered material to maximum 40 percent of its uncompressed size.
- 6. Placement:
  - a. Place foamed material in layers to ensure homogenous density, filling cavities and spaces.
  - b. Place sealant to completely seal junctions with adjacent dissimilar materials.
- 7. Placement: Place intumescent coating in sufficient coats to achieve required rating.
- 8. Dam Material: To remain.
- 9. Fire-Rated Surfaces:
  - a. Seal opening at floor, wall, partition, ceiling, and roof.
  - b. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
  - c. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
  - d. Pack void with backing material.
  - e. Seal ends of sleeve with UL-listed fire-resistive silicone compound to meet fire rating of structure being penetrated.
- 10. If cable tray, bus, cable bus, conduit, wireway, trough, and piping assembly penetratse fire-rated surface, install firestopping product according to manufacturer instructions.
- 11. Nonrated Surfaces:
  - a. Seal opening through non-fire-rated wall, partition, floor, ceiling, and roof opening.
  - b. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
  - c. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
  - d. Install type of firestopping material as recommended by manufacturer.

12. Occupied Spaces:

- a. Install escutcheons, floor plates, or ceiling plates where conduit penetrates non-fire-rated surfaces in occupied spaces.
- b. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

13. Exterior Wall Openings below Grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place according to manufacturer instructions.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

## SECTION 23 05 53

### IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Labels.

###### B. Related Sections:

1. See General Requirements - Painting and Coating: Execution requirements for painting specified by this section.

##### 1.2 REFERENCES

- A. ASME A13.1 - Scheme for the Identification of Piping Systems: The American Society of Mechanical Engineers; 2007.
- B. ASTM D 709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

##### 1.3 SUBMITTALS

- A. See General Requirements for Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

##### 1.4 CLOSEOUT SUBMITTALS

- A. See General Requirements for Execution and Closeout Requirements.

- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

#### 1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

#### 1.7 PRE-INSTALLATION MEETINGS

- A. See General Requirements for Administrative Requirements: Pre-installation meeting.
- B. Convene minimum two-weeks prior to commencing work of this section.

#### 1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.9 EXTRA MATERIALS

- A. See General Requirements - Execution and Closeout Requirements: Spare parts and maintenance products.

### PART 2 - PRODUCTS

#### 2.1 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Control Panels: Nameplates.
- D. Dampers: Ceiling tacks, where located above lay-in ceiling.
- E. Heat Transfer Equipment: Nameplates.
- F. Major Control Components: Nameplates.
- G. Plumbing and Hydronic Piping: Plastic Pipe Markers.

H. Pumps: Nameplates.

I. Ductwork: Tags or Stencils

## 2.2 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com).
2. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
3. Seton Identification Products: [www.seton.com](http://www.seton.com).
4. Or Approved Equal.

B. Product Description: Laminated three-layer plastic with engraved letters on light contrasting background color.

1. Letter Color: White.
2. Letter Height: 1/2 inch (12 mm).
3. Background Color: Black.
4. Plastic: Conform to ASTM D 709

## 2.3 TAGS

A. Plastic Tags

1. Manufacturers:

- a. Advanced Graphic Engraving: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com).
- b. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- c. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
- d. Seton Identification Products: [www.seton.com](http://www.seton.com).
- e. Or Approved Equal.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags

1. Manufacturers:

- a. Advanced Graphic Engraving: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com).
- b. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- c. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
- d. Seton Identification Products: [www.seton.com](http://www.seton.com).
- e. Or Approved Equal.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

## 2.4 STENCILS

A. Stencils

1. Manufacturers:

- a. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- b. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
- c. Seton Identification Products: [www.seton.com](http://www.seton.com).
- d. Or Approved Equal.

B. Stencils: With clean cut symbols and letters of following size:

1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.

C. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

## 2.5 PIPE MARKERS and PIPE STICKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers (Applied to insulated and wrapped piping).

1. Plastic Pipe Markers: Factory fabricated, wrap-around, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
2. Size (including insulation) Pipe O.D. (inches) = Letter Size (inches):
  - a. 0.75" – 1" = 1/2" Letters.
  - b. 1.25" – 2.375" = 3/4" Letters.
  - c. 2.5" – 7.875" = 1.25" Letters.
  - d. 8" – 9.875" = 2.5" Letters.
  - e. 10" and larger = 3.5" Letters.

C. Plastic Tape Pipe Markers (Applied to painted uninsulated or wrapped piping).

1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
2. Size (including insulation) Pipe O.D. (inches) = Letter Size (inches):
  - a. 0.75" = 1/2" Letters.
  - b. 1" – 2.5" = 3/4" Letters.
  - c. 2.5" – 7.875" = 1.25" Letters.
  - d. 8" – 9.875" = 2.5" Letters.
  - e. 10" and larger = 3.5" Letters.

## 2.6 UNDERGROUND WARNING TAPE

A. Underground Warning Tape



1. Manufacturers:
  - a. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
  - b. Kolbi Pipe Marker Co.: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com).
  - c. Seton Identification Products: [www.seton.com](http://www.seton.com).
  - d. Or Approved Equal.
- B. Description: Polyethylene tape with metallic core for detection and location of piping with metal detector resistant to acids, alkalis and other soil components.
  1. Size: 0.004 inch6 inches
  2. Printed text as selected by Architect/Engineer in contrasting color and repeated at maximum 36 inches intervals.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates on all HVAC and plumbing equipment. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- C. Install with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install wrap-around pipe markers on all insulated and wrapped plumbing piping including: Storm, Sanitary, CW, HW, DHWR (recirculation), Tempered Water, and condensate. Include flow direction arrows on recirculation piping (at least one flow direction arrow next to label in each room).
- F. Install adhesive pipe markers on all painted (uninsulated) piping located indoors including: Natural Gas, and Sanitary vent (not installed within walls). For indoor exposed natural gas lines, attach yellow pipe labels with "GAS" in black lettering, at maximum 5 foot spacing.
- G. Install wrap-around pipe markers on all insulated and wrapped HVAC piping including: HWS, HWR, CHWS, CHWR, HPWS, HPWR, Condensate, STEAM (include pressure PSI) and STEAM-CONDENSATE. Include flow direction arrows on all piping. Install at least one flow direction arrow on each main pipe branch. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

- H. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- I. Identify control panels and major control components outside panels with plastic nameplates including: AHU Control Panels and Control Sensors and Thermostats.
- J. Identify valves in main and branch piping with tags.

END OF SECTION

## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Testing, adjusting, and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.

###### B. This section does not include:

1. Testing heat exchangers and pressure vessels for compliance with safety codes.
2. Specifications for materials for patching mechanical systems.
3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the system sections for materials and installation requirements.
4. Requirements and procedures for piping and ductwork systems leakage tests.

###### C. The following systems require test and balance:

1. (4) new rooftop units (fresh air, supply air, static profile).
2. (1) new computer room air conditioner (Alternate #1)
3. No distribution test and balance included.

##### 1.2 REFERENCES

###### A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

###### B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

###### C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

###### D. Testing Adjusting and Balancing Bureau:

1. TABB - International Standards for Environmental Systems Balance.

### 1.3 SUBMITTALS

- A. Reports:
  - 1. General: Submit testing, adjusting, and balancing reports bearing the seal and signature of the test and balance engineer or the signature and list of qualifications of a test and balance technician. The reports shall be proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below.
- B. See General Requirements - Submittal Procedures: Submittal procedures.
- C. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Submit draft copies of report for review prior to final acceptance of Project.
- F. Furnish reports in electronic PDF format and binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State standards and ASHRAE 90.1-2013.
- B. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

### 1.5 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum ten years documented experience certified by AABC Certified or by NEBB Certified by TABB.

### 1.6 PRE-INSTALLATION MEETINGS

- A. See General Requirements - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

### 1.7 SEQUENCING

- A. See General Requirements - Summary: Work sequence.

- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

## PART 2 - PRODUCTS

- 2.1 Not Used.

## PART 3 - EXECUTION

### 3.1 PRELIMINARY PROCEDURES

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
  1. Equipment is operable and in a safe and normal condition.
  2. Temperature control systems are installed complete and operable.
  3. Proper thermal overload protection is in place for electrical equipment.
  4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. Fire dampers are in place and open.
  7. Coil fins have been cleaned and combed.
  8. Access doors are closed and duct end caps are in place.
  9. Air outlets are installed and connected.
  10. Duct system leakage has been minimized.
  11. Correct fan rotation.
  12. Walk the system from the system air handling equipment to air outlets and inlets to determine variations of installation from design.
  13. Check all damper types for correct and locked position, and temperature control for completeness of installation before starting fans.
  14. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
  15. Lubricate all motors and bearings
  16. Check fan belt tension
- B. Report to Architect/Engineer any major problems, defects or deficiencies noted during performance of services. Also include major problems or deficiencies in the written report.
- C. Promptly report abnormal conditions in mechanical systems or conditions, which prevent system balance.
- D. Beginning of work means acceptance of existing conditions.

### 3.2 PERFORMING TESTING, ADJUSTING AND BALANCING ON AIR SYSTEMS

- A. Perform testing, adjusting and balancing procedures on each system identified in drawing, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.

- B. Unless specifically instructed in writing, all work in this specification section is to be performed during the normal workday.
- C. In areas containing ceilings, remove ceiling tile to accomplish balancing work. Replace tile when work is complete and provide new tile for any tile that was damaged by this procedure. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the owner representative.
- D. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch to maintain system integrity and pressure rating of systems.
- E. In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
- F. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- G. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- H. All Air Systems shall be balanced using a procedure, which results in minimum restrictions being imposed. At completion of balancing:
  - 1. At least one damper for an outlet/inlet shall be fully open on every branch duct.
  - 2. At least one branch duct balancing damper shall be fully open on every trunk duct.
  - 3. At least one trunk (zone) balancing damper shall be fully open from each Fan System.
  - 4. Supply/exhaust RPM shall be set so that the static pressure at the terminal that is most difficult to maintain is adequate, but not excessive.
- I. Measure and record system measurements at the fan to determine total flow. Adjust equipment as required to yield specified total flow at ventilation unit and at terminals. Proceed taking measurements in mains and branches as required for final terminal balancing. Perform terminal balancing to specified flows after balancing branch dampers, deflectors, extractors and valves.
- J. Provide fan and motor drive sheave adjustments necessary to obtain design performance. Once drive sheave diameters have been established, replace all adjustable sheaves with solid pulleys (at Test and Balance Contractor Cost). Include in scope of services drive changes specifically noted on drawings, if any. If work indicates that any drive or motor is inadequate for the application, advise the owner representative by giving the representative properly sized motor/drive information (in accordance with manufacturers original service factor and installed motor horsepower requirements). Any changes shall keep the duct system within its design limitations with respect to the speed of the device and pressure classification of the distribution system. Material costs for sheave changes as well as time and material for motor changes will be considered a reimbursable expense and will require an itemized cost breakdown of all time and motor/drive changes submitted to owner representative; prior authorization is needed before this work is started.

- K. Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty filter.
- L. Adjust outside air, return air and relief air dampers for design conditions at both the minimum and maximum settings and record both sets of data (and test methodology). If necessary, Test and Balance Contractor should return when an adequate temperature difference between the return air and outside air temperatures exists in order to determine minimum outside air damper position.
- M. Balance modulating dampers at extreme conditions and record both sets of data. Balance variable air volume systems at maximum air flow rate (full cooling) and minimum flow rate (full heating) and record all data.
- N. Final air system measurements to be within the following range (unless directed otherwise by Engineer) of the specified CFM:
  - 1. Fans -5% to +10% of design value
- O. Permanently mark equipment settings including damper positions, valve positions, and control settings. Set and lock memory stops.
- P. Leave systems in proper working order by replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.

### 3.3 DEFICIENCIES

- A. Notify General Contractor, Owner, and Owner Representative of any installation deficiencies found by the Test and Balance Contractor that were specified and/or shown on the Contract Documents. The Owner Representative will then instruct the General Contractor to correct the deficient work. All corrective work to be done at no cost to the owner.

### 3.4 INSTRUMENTATION

- A. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be in accordance with the requirements of Reference Standards and instrument manufacturer's specifications.
- B. All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments to be in accordance with the requirements of Reference Standards.
- C. Provide all necessary tools, scaffolding and ladders and other necessary instruments.

### 3.5 APPROVED TEST AND BALANCE CONTRACTORS

- A. Qualifications: A third party testing and balancing professional with technician's having at least 10-years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Codes and Standards: The Test and Balance Contractor shall be certified by one the following Test and Balance Organizations.

1. National Environmental Balancing Bureau (NEBB).
2. National Balancing Council (NBC).
3. Associated Air Balance Council (AABC).

C. Approved Test and Balance Contractors:

1. Due to prior test and balance issues, only test and balance contractors listed below are pre-approved for this job. Others can request approval by Engineer prior to bidding.
  - a. Ener-Tech Testing, Lee Marshall, 810-579-5000
  - b. Integrity Test and Balance, Nathan Heikkila, 231-499-3594
  - c. International Test and Balance, 248-559-5864
  - d. Hi-Tech Test and Balance, Bill Haire, 989-695-5498

D. Report Format and Contents

1. Format: Bind report forms in three-ring binders or portfolio binders. Label edge and binder front cover with label identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions, separated by divider tabs.
2. Report Tags and Labels: Use equipment tags and labels (for example: AHU-1, RTU-1, SD-1, etc.) as listed on the Mechanical Drawings, when labeling report equipment.

General Information:

- a. Summary and Title Page
- b. Air Systems
- c. Water Systems
- d. Special Systems

E. Report Forms

1. Title Page:

- a. Name of Testing, Adjusting, and Balancing Agency
- b. Address of Testing, Adjusting, and Balancing Agency
- c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
- d. Project name
- e. Project location
- f. Project Architect
- g. Project Engineer
- h. Project Contractor
- i. Project altitude
- j. Report date

2. Summary Comments:

- a. Design versus final performance
- b. Notable characteristics of system
- c. Description of systems operation sequence
- d. Summary of outdoor and exhaust flows to indicate building pressurization
- e. Nomenclature used throughout report
- f. Test conditions



3. Instrument List:
  - a. Instrument
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Range
  - f. Calibration date
  
4. Air Systems:
  - a. Names and initials of personnel performing the balancing (on each form)
  - b. Dates balancing was performed (on each form)
  - c. Weather conditions at the time of the test (especially temperature)
  - d. All motor rated data: voltages, amps, RPM, HP, manufacturer, starter and overload protective device sizes
  - e. All motor operating data (before and after adjustments) voltages, amps, RPM, HP, BHP, and sheave size/rating and manufacturer
  - f. All fan data (design and operating): supply and return CFM, operating static pressures (suction, discharge, and fan static), fan sheave, belt size, fan RPM
  - g. All drive changes necessitated to obtain design capacities
  - h. List actual minimum outside air volumes measured for each system and the corresponding control setpoint
  - i. Heating and cooling coil entering and leaving air temperatures during test (as a reference)
  
5. Test and Balance Summary:
  - a. Provide sheet describing mechanical system deficiencies.
  - b. Describe objectionable noise or drafts found during testing, adjusting and balancing.
  - c. Provide recommendations for correcting deficiencies and unsatisfactory performances and indicate whether modifications required are: within the scope of the contract; design related; or installation related.
  - d. Static pressure and CFM values at each fan system.
  - e. For each fan system, outside air damper position that provides required minimum outside air.
  
6. Electric Motors:
  - a. Manufacturer
  - b. Model/Frame
  - c. HP/BHP and kW
  - d. Phase, voltage, amperage; nameplate, actual, no load
  - e. RPM
  - f. Service factor
  - g. Starter size, rating, heater elements
  - h. Sheave Make/Size/Bore
  
7. V-Belt Drive:
  - a. Identification/location

- b. Required driven RPM
  - c. Driven sheave, diameter and RPM
  - d. Belt, size and quantity
  - e. Motor sheave diameter and RPM
  - f. Center to center distance, maximum, minimum, and actual
8. Air Cooled Condenser:
- a. Identification/number
  - b. Location
  - c. Manufacturer
  - d. Model number
  - e. Serial number
  - f. Entering DB air temperature, design and actual
  - g. Leaving DB air temperature, design and actual
  - h. Number of compressors
9. Cooling Coil Data:
- a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Entering air DB temperature, design and actual
  - g. Entering air WB temperature, design and actual
  - h. Leaving air DB temperature, design and actual
  - i. Leaving air WB temperature, design and actual
  - j. Saturated suction temperature, design and actual
  - k. Air pressure drop, design and actual
10. Heating Coil Data:
- a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Entering air temperature, design and actual
  - g. Leaving air temperature, design and actual
  - h. Air pressure drop, design and actual
11. Duct Traverse:
- a. System zone/branch
  - b. Duct size
  - c. Area
  - d. Design velocity
  - e. Design air flow

- f. Test velocity
- g. Test air flow
- h. Duct static pressure
- i. Air temperature
- j. Air correction factor

12. Sound Level Report:

- a. Location
- b. Octave bands - equipment off
- c. Octave bands - equipment on
- d. RC level - equipment on

13. Vibration Test:

- a. Location of points:
  - 1) Fan bearing, drive end
  - 2) Fan bearing, opposite end
  - 3) Motor bearing, center (when applicable)
  - 4) Motor bearing, drive end
  - 5) Motor bearing, opposite end
  - 6) Casing (bottom or top)
  - 7) Casing (side)
  - 8) Duct after flexible connection (discharge)
  - 9) Duct after flexible connection (suction)
- b. Test readings:
  - 1) Horizontal, velocity and displacement
  - 2) Vertical, velocity and displacement
  - 3) Axial, velocity and displacement
- c. Normally acceptable readings, velocity and acceleration
- d. Unusual conditions at time of test
- e. Vibration source (when non-complying)

END OF SECTION

SECTION 23 07 00  
HVAC INSULATION

PART 1 GENERAL

This section includes thermal insulation specifications for all plumbing and HVAC equipment.

- A. All insulation must meet or exceed State of Michigan Commercial Uniform Energy Code and standards specified by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers, ASHRAE 90.1-2013.

1.1 QUALITY ASSURANCE

- A. Bidders shall specialize in mechanical insulation application and have a minimum of three years' experience, or pre-approval for bidding from the engineer.
- B. Furnish insulation, jackets, coverings, sealers, mastics, and adhesives with flame-spread index of 25 or less, and smoke-developed index of 50 or less, in accordance with the Michigan Mechanical Code (MMC), ASTM E-84, NFPA 255, or UL 723.
- C. Insulation shall be furnished and installed in compliance with the National Commercial & Industrial Insulation Standards, Refer to [www.insulation.org/index](http://www.insulation.org/index) for manual information.

1.2 PERFORMANCE SPECIFICATION

- A. Insulation materials furnished and installed hereunder shall meet the fire hazard requirements of applicable building codes when tested in composite form per one of the following nominally equivalent test methods:
  - 1. American Society for Testing of Materials           ASTM E-84
  - 2. Underwriters' Laboratories, Inc.                    UL 723 (CAN/ULC-S102-M88)
  - 3. National Fire Protection Association                NFPA 255
- C. As specified in ASTM E-84, all insulation shall have a flame spread index not exceeding 25, and a smoke-developed index not exceeding 50.

1.3 SUBMITTALS

- A. Provide manufacturer data and installation sheets for each type of insulation material used.
- B. See General Requirements and/or Mechanical General Requirements for required format.
- C. Shop drawing submittals shall include:
  - 1. Job Name
  - 2. Supplier and contractor name, address, phone, and fax.
  - 3. Material specifications and intended area of use.

## PART 2 PRODUCTS

### 2.1 APPROVED MANUFACTURERS

- A. Owens Corning
- B. Certainteed
- C. Knauf
- D. 3M
- E. Insulation Solutions
- F. TVM Building Products
- G. Pabco-Childers Metals
- H. Armacell Engineered Foams (formerly Armstrong Insulation Company)
- I. TruBro
- J. McGuire Manufacturing Company

## PART 3 MATERIALS

### 3.1 TYPE 1 - NON-FLEXIBLE, JACKETED, FIBERGLASS PIPE INSULATION

- A. Fiberglass pipe insulation
- B. Heavy density resin bonded inorganic fibers
- C. Formaldehyde Free
- D. Hinged sections to slip over pipe
- E. Smooth, reinforced, vapor retardant, all service jacket (ASJ)
- F. Longitudinal, pressure sensitive adhesive self-sealing lap seal and butt seal
- G. Approved for use up to 850 deg. F
- H. Meets ASTM C 547 (mineral fiber insulation), ASTM 1136 (vapor barrier), ASTM C 795 (austenitic stainless steel)
- I. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A

3.2 TYPE 2 - NON-FLEXIBLE, PVC JACKETED, FIBERGLASS PIPE INSULATION

- A. Same as Type 1, except shall be securely covered with 15 mil PVC jacket.
- B. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A

3.3 TYPE 3 - FOIL-BACKED, ALL SERVICE DUCT WRAP INSULATION

- A. 0.75 pounds per cubic feet (pcf)
- B. Thermal resistance,  $R = 6.0 \text{ hr-sf-F/Btu}$  (2" thick)
- C. Foil, reinforced, kraft low permeance vapor retarder backing (foil-backed)
- D. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A
- E. Paper-backed insulation typically does not meet ASTM E-84, and shall not be approved.

3.5 TYPE 5 - FLEXIBLE, CLOSED-CELL, PIPE INSULATION

- A. Closed-cell, flexible, elastomeric, piping insulation; or Foam Glass Brand insulation with Pit Wrap (Foam Glass insulation includes water resistance vapor barrier, and does not require a separate vapor barrier).
- B. Thermal Conductivity,  $K = 0.27 \text{ Btu-in/hr-sf-F}$
- C. Vapor transmission 0.08 perm-in
- D. Non CFC, HFC, HCFC, manufactured, and formaldehyde free
- E. Mold and mildew resistant
- F. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A
- G. Include seam and butt joint adhesive

3.6 TYPE 6 - DUCT LINER FOR THERMAL INSULATION PURPOSES

- A. Bonded glass fiber blanket
- B. Thermal Conductivity,  $K = 0.25 \text{ Btu-in/hr-SF-F}$
- C.  $R = 8.0 \text{ hr-sf-F/Btu}$  (2" thick)
- D. Bacterial and fungi resistance ASTM C 1338 and ASTM G-21 (fungi), ASTM G-22 (bacteria)
- E. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A
- F. Sheet metal contractor to provide and install duct liner
- G. Include manufacturer specified fasteners and adhesives.

- H. See HVAC Ductwork Specification Section 15890 for further installation info.
- I. Reference Venture Clad 1577CW exterior duct jacket, -30F to +300F, 6.0 mils, 0.000 Perms. UL Classified. PSTC 101, 107,, 131, ASTM D 1000, D 624, E 162, E 622, E 96.

### 3.7 TYPE 7 - ZERO-CLEARANCE DUCT WRAP FOR TYPE 1 GREASE-LADEN DUCTWORK AND HOODS

- A. Fire-resistant wrap consisting of inorganic blanket encapsulated with scrim-reinforced foil
- B. Used as alternative to 1 and 2 hour rated shaft assemblies
- C. Zero-clearance, two (2) hour fire rating
- D. Non-asbestos
- E. Zero smoke and fire developed index
- F. ASTM C 411, ASTM C 518, ASTM E-84, ASTM E-19, ASTM E-136, ASTM E-814
- G. UL 1978
- H. Include silicone seam sealants per manufacturer recommendations and specifications.

### 3.8 TYPE 8 - SPECIALTY INSULATION COVERS

- A. Closed-cell, flexible, elastomeric, sheet or roll insulation
- B. 1" thick
- C. Thermal Conductivity,  $K = 0.27$  Btu-in/hr-sf-F
- D. Vapor transmission 0.08 perm-in
- E. Non CFC, HFC, HCFC, manufactured, and formaldehyde free
- F. Mold and mildew resistant
- G. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A
- H. Include seam and butt joint adhesive
- I. Field fabricated insulated sheet metal cover to cover chilled-water pump casing and flanges
- J. Removable and reusable sheet metal cover

### 3.9 TYPE 9 – BURIED SUPPLY DUCT & RADIANT FLOOR AND SNOWMELT INSULATION

- A. Insulated Tarp
  1. High density closed-cell foam and high density polyethylene bubble-wrap sandwiched between cross-woven polyethylene sheets with reflective aluminum inner backing.
  2. Thickness = 1" or meeting R-value below.

3. Thermal resistance,  $R = 10.0 \text{ hr-sf-F/Btu}$
4. Permeance = .002 perms
5. Temperature rating = 180 deg. F to -60 deg. F
6. Compressive strength for use up to 90 psi (12,960 lbf/sf), for use under sidewalks, residential and heavy equipment garages, garage aprons, and driveways.
7. Not approved for other mechanical thermal insulation uses

B. High Density Polystyrene Insulation with Vapor Barrier

1. High density extruded polystyrene sheets
2. Thickness = 2"
3. Thermal resistance,  $R = 10.0 \text{ hr-sf-F/Btu}$
4. Compressive strength to meet use
  - a. 25 psi (3600 lbf/sf), typical for radiant floor heat, sidewalks, and residential garages.
  - b. 40 psi (5760 lbf/sf), for light commercial garages, garage aprons, and driveways.
  - c. 60 psi (8640 lbf/sf), for medium duty commercial garages, garage aprons, and driveways.
  - d. 100 psi (14,400 lbf/sf), for heavy equipment garages, garage aprons, and driveways.
  - e. Refer to structural engineering and architectural drawings and specifications for further information, and verify use with general contractor.
5. Install separate 4 mil polyethylene roll sheet underneath high density sheets for vapor barrier, permeance less than 0.08 perms
6. ASTM D1621, ASTM E 96
7. Not approved for other mechanical thermal insulation uses.

### 3.10 ACCESSORIES

- A. All insulation accessories shall meet state and local fire codes, and shall meet NFPA 90A for use within air plenums.
- B. Closure Materials including butt strips, bands, wires, staples, mastics, adhesives, caulks or sealants, pressure-sensitive tapes
- C. Support materials including hanger straps, hanger rods, saddles, and support rings, wire mesh, plastic ties, etc.
- D. Fastener materials including welded pin or adhesive pin mechanical fasteners, speed clips, pressure-sensitive tapes, caulks or sealants.
- E. Jackets and Prefabricated Fitting Covers
  1. PVC Jackets
    - a. Minimum 0.028 inch thick
    - b. Bacterial and mildew resistant
    - c. Designed for exterior use
  2. Aluminum Jackets
    - a. Aluminum Alloy
    - b. 0.010" thick
    - c. Moisture barrier
    - d. Smooth finish
    - e. Include 45 or 90 degree short and long radius elbows, and end caps as necessary



PART 4 INSTALLATION

4.1 INSULATION TYPE AND REQUIRED THICKNESS

Refer to the following Insulation Schedule areas of insulation use and insulation thickness. If a separate Plumbing Insulation Specifications is included do not apply this section for domestic CW, HW, and sanitary piping insulation requirements. Note: all PVC piping in plenums must meet insulated with jacket complying with ASTM E 84, UL-723.

TYPE OF PIPING	TYPE	THICKNESS
Domestic Cold Water Pipe, CW All Sizes	1	1/2"
Domestic Hot Water Pipe, HW All Sizes	1	1"
Roof and Storm Drains All Sizes	1	1"
Exposed Roof and Storm Drains All Sizes	2	1"
P-Traps and HW/CW Barrier Free Lavatories and Sinks (All Sizes)	4	1/8"
Heating Hot Water Pipe, HWS and HWR (All Sizes)	1	1"
Chilled Water Pipe, CHWS and CHWR (All Sizes)	1	1"
Condensate Piping (All Sizes)	1	1/2"
Exposed Condensate Piping (All Sizes)	2	1/2"
Exposed Heating Hot Water Pipe, HWS and HWR (All Sizes)	2	1"
Exposed Chilled Water Pipe, CHWS and CHWR (All Sizes)	2	1"
Underground Hot Water Supply and Return Pipe All Sizes	5	1"
Underground Snowmelt or Radiant Heat Piping Mains (All Sizes)	5	1"

DUCTWORK TYPE (ALL SIZES)

Supply Air Ductwork (Exposed Duct Does not Apply)	3	2"
Supply Air Buried Duct Under Building	9	1" (R-3.5)
Supply Air Buried Duct Outside of Building	9	2" (R-6)
Return Air Ductwork in Unconditioned, Concealed, Inaccessible Spaces	3	2"
Return Air Ductwork in Plenums or Conditioned Spaces All Sizes	None	
Return Air Buried Ductwork Under Building	None	
Return Air Buried Ductwork Outside of Building	9	2" (R-6)
Outdoor Supply and Return Ductwork	6	2"
Fresh Air (Outdoor Air) Ductwork	3	2"
Combustion Air Duct Work	3	2"
Exhaust Air Ductwork in Unconditioned or Concealed	3	1-1/2"
Exhaust Air Ductwork in Plenums or Conditioned Spaces	None	
Relief Air Ductwork in Unconditioned or Concealed	3	1-1/2"

Relief Air Ductwork in Plenums or Conditioned Spaces                                  None

EQUIPMENT TYPE (ALL SIZES)

Refrigerant Suction and Liquid Lines	5	1"
Chilled Water Pumps	8	1"
Chilled Water Air Separators	8	1"
Radiant Floor and/or Snowmelt Above	9	See Spec

4.2 GENERAL INSTRUCTIONS

- A. Install all materials in strict accordance to manufacturer's specifications.
- B. Install insulation after testing and testing approval is completed, in coordination with the mechanical contractor.
- C. Install insulation after heat tracing, or buried pipe tracing, is installed.
- D. Butt edges of insulation together, and seal joints with proper adhesives or jackets per manufacturer specifications.
- E. Seal insulation butt joints with 3" pressure-sensitive tape.

4.3 TYPE 1, PIPE INSULATION

- A. Clean all piping free of dirt, grease, flux, etc.
- B. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
- C. Butt pipe insulation against hanger inserts. Secure with self-sealing facing tabs or 3" wide pressure sensitive tape.
- D. On non-serviceable unions, flanges, pipe terminations etc., provide prefabricated fitting covers.
- E. On serviceable items use removable and reusable, prefabricated fitting covers.

4.4 TYPE 2, PVC JACKETED PIPE INSULATION

- A. Same as Type 1 insulation, with PVC jacket installed over pipe insulation.
- B. PVC jacketing shall be designed to fit over Type 1 insulation.
- C. Install PVC jacketing per manufacturer instructions.

- D. Install prefabricated PVC jacketing for:
  - 1. Elbows
  - 2. End-Caps
  - 3. Chilled water systems listed below
  - 4. Non-serviceable hot water piping systems listed below.
- E. Secure PVC jacketing with approved PVC sealant and banding.

#### 4.5 TYPE 3, FOIL-BACKED ALL-SERVICE DUCT INSULATION

- A. Clean all ductwork free of dust and grease. Verify that ductwork is dry, and joints are tightly sealed, and joint sealant is applied.
- B. Completely cover all supply, outdoor air, and/or return and exhaust ductwork as specified in the Insulation Schedule.
- C. Remove a 2" piece of insulation from the foiled backing at the end of the piece of duct wrap to form an overlapping stapling and taping flap seam.
- D. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the 2" stapling and taping flap overlapping. If ducts are rectangular or square, install so insulation is not excessively compressed at corners.
- E. Staple seams at 6" on-center intervals with outward clinching 1/2" steel staples.
- F. Seal seams with 3" pressure sensitive tape. Cloth duct tape of any color or finish using reclaimed rubber adhesives is not approved for use.
- G. Where rectangular ducts are 24" (600mm) in width or greater, duct wrap insulation shall be additionally secured to the bottom of the duct with mechanical adhesive pin-fasteners, and speed clips.

#### 4.7 TYPE 5, FLEXIBLE, CLOSED-CELL, PIPE INSULATION

- A. Clean all piping free of dirt, grease, flux, etc.
- B. Install insulation over all piping, unions, or flanges.

#### 4.12 EXTERIOR DUCTWORK

- A. All supply and return exterior ductwork shall be insulated using minimum R-13 rigid polyisocyanurate insulation, lined with 1/2" duct liner (for sound), mechanically fastened to galvanized G-90 inner duct, sealed water tight, with 0.8 mill aluminum exterior skin or Ventureclad 1577CW exterior duct jacket installed per manufacturer installation instructions.

END OF SECTION

## SECTION 23 09 01

### DIGITAL TEMPERATURE CONTROL SYSTEM

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Temperature control System (TCS), utilizing direct digital controls.
- B. Project Note: Existing Johnson Controls DDC TCS is obsolete and has limited support. New TCS can reuse existing sensors and damper actuators if possible. Floor plan graphics are to be reused or regenerated. Distribution Test and Balance is not included in this project, TCC shall reuse calibration and setpoints from existing Variable Air Dampers. Owner will provide access to existing TCS prior to demolition of system.
- C. The Temperature Control Contractor shall be herein referred to the TCC.  
City of Owosso herein shall be referred to the Owner.  
Spicer Group herein shall be referred to as the Engineer.

##### 1.2 RELATED WORK

- A. Products Supplied but Not Installed Under This Section:
  - 1. HVAC Equipment
- B. Products Installed but Not Supplied Under This Section:
  - 1. Owner-provided computer (if required).
  - 2. See System Description below.
- C. Products existing or new with the Work of This Section:

NOTE: All new equipment as noted on plans must be fully integrated per this specification and Sequence of Operations.

- 1. (4) new packaged roof top units.
  - 2. (1) new CRAC unit.
  - 3. Existing Variable Air Dampers (no reheat, bypass air to return plenum)
  - 4. Existing temperature sensors and thrmostats.
- D. Work Required Under Other Divisions Related to This Section:
  - 1. Power wiring to line side of equipment.
  - 2. Provision and wiring devices relating to fire alarm system.

##### 1.3 RELATED SECTIONS

- A. Section 23 00 00 – HVAC, 23 00 53 Identification for HVAC Piping and Equipment.

##### 1.4 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Tridium 4.2 (or latest version) with HTML/5 Temperature Control System (TCS), utilizing Direct Digital Bacnet Protocol Controls as noted on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over an open protocol bus (Examples: BACnet, Modbus).
1. The intent of this specification is to provide a fully, non-proprietary, TCS comprised of non-proprietary equipment controller and front-end controller.
  2. All new controllers shall be Bacnet protocol.
  3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
  4. All control devices furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable as base-bid.
  5. Any control vendor that shall provide additional TCS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
  6. The TCS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall Niagara 4 Framework server.
  7. The TCC shall coordinate the installation of the new Tridium 4 software onto a virtual server provided by the City of Saginaw.
    - a. The TCC shall provide written request through the Engineer all necessary server requests, server requirements, IP addresses, etc., as part of the approved shop drawing process.
  8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the TCS.
  9. All hardware licenses and certificates shall be stored on a local external hard drive employing encrypted "safe boot" technology. TCC shall coordinate external drive device, to be provided by Owner.
  10. To ensure quality, all products shall be Made in America, and be provide through Cochrane Supply. Contact Greg Widenmier for sales: 989-859-6062.
- B. NiCS REQUIREMENTS: All Niagara software licenses for this project shall have a 100% open, Tridium Vykon Niagara Compatibility Statement (NICS) with KMC Equipment Controllers.
1. Brand ID = Open
  2. Station Compatibility In = All "\*"
  3. Tool Compatibility In = Open or Open "All"
  4. Tool Compatibility Out = "All"

All Passwords shall be given to the Owner and shall be verified by the Engineer. THE OWNER AND CONTRACTOR MUST CREATE PASSWORD TOGETHER. NO RESETTING OR MANUFACTURER RESETTING OF PASSWORD IS AVAILABLE.

Note: It is the requirement of this specification that the Tridium Vykon hardware and software system installed by the Contractor shall be 100% accessible by any other Contractor the Owner wishes to employ for the lifespan of the Tridium Vykon system (no less than 20 years). The NICS shall be set-up so that there is no limitation to the access, copying, and modification of

programming, sequencing, coding, graphics, passwords, etc.

- C. All products of the TCS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
1. Federal Communications Commission (FCC), Rules and Regulations, Volume II -July 1986 Part 15 Class A Radio Frequency Devices.
  2. FCC, Part 15, Subpart B, Class B
  3. FCC, Part 15, Subpart C
  4. FCC, Part 15, Subpart J, Class A Computing Devices.
  5. UL 504 - Industrial Control Equipment.
  6. UL 506 - Specialty Transformers.
  7. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces.
  8. UL 916 - Energy Management Systems All.
  9. UL 1449 - Transient Voltage Suppression.
  10. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.
  11. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
  12. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
  13. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits.
  14. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
    - a. NEMA 250 - Enclosures for Electrical Equipment.
    - b. NEMA ICS 1 - Industrial Controls and Systems.
    - c. NEMA ST 1 - Specialty Transformers.
    - d. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-1999.
    - e. CE 61326.
    - f. C-Tick.
    - g. cUL.

## 1.5 SPECIFICATION NOMENCLATURE

- A. The term Control Contractor, Temperature Control Contractor (TCC) shall all serve as Contractor in this specification and project.
- B. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
  2. AI: Analog Input.
  3. AO: Analog Output.
  4. Analog: Continuously variable state over stated range of values.
  5. TCS: Temperature control System.
  6. DDC: Direct Digital Control.
  7. Discrete: Binary or digital state.
  8. DI: Discrete Input.
  9. DO: Discrete Output.

10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
12. GUI: Graphical User Interface.
13. HVAC: Heating, Ventilating and Air Conditioning.
14. IDC: Interoperable Digital Controller.
15. ILC: Interoperable Lon Controller.
16. LAN: Local Area Network.
17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
18. Motorized: Control device with actuator.
19. NAC: Network Area Controller.
20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
22. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
23. Operator: Same as actuator.
24. PC: Personal Computer.
25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its dataTCS values with all other devices connected to network.
26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output TCSed on both amount and duration of change in controller variable (reset control).
28. PICS: BACnet Product Interoperability Compliance Statement.
29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal TCSed on proportional error, its time history (reset) and rate at which it's changing (derivative).
30. Point: Analog or discrete instrument with addressable dataTCS value.
31. WAN: Wide Area Network.

## 1.6 SUBMITTALS

### A. Shop Drawings:

1. See General Requirements and HVAC General Requirements.
2. Submit electronic, Portable Document Format (PDF), submittals to Construction Manager and Engineer for review.
3. Submit complete manufacturers shop drawings of all equipment, accessories and controls, including capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data.
4. Approval of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under all Contract Documents, and does not approve changes in time or cost.

5. After approval, each Contractor and Subcontractor is responsible to provide information to all other trades involved in or affected by installation of his equipment.

B. Operating and Maintenance Instruction and Manuals:

1. Each Contractor shall provide for all equipment (3) bound and indexed sets of operating and maintenance instructions to Engineer for approval. Manual shall include a complete set of shop drawings.
2. Submit manuals prior to Substantial Completion. Final payment and release of Retainage shall follow submission of manuals.

## 1.7 QUALITY ASSURANCE

A. Approved installation Contractors are:

1. Smart Buildings Services – Randy Stockfish 231-357-1650
2. Air-N-Energy – Mike Bobrowski 616-443-5260
3. Control Resource – Justin Holmes 616-644-6535
4. ControlNET – 616-777-0037
5. Temperature Control, Inc. – 231-922-1862
6. Johnson Controls, Inc. by voluntary alternate only.
7. Others by Engineer approval only prior to bidding.

- B. The Contractor shall have a full service DDC office within 100 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.

- C. The project manager or lead installer and programmer of the project employed by the Contractor shall be available on-site, the same day within 4 hours of a requested service call.

- D. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized temperature control systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 5 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop.

- E. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

## 1.8 PRE-INSTALLATION MEETINGS

- A. Coordinate with Construction Manager and/or Engineer.

## 1.9 DELIVERY, STORAGE AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.



## 1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

## 1.11 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Approved equipment controller manufacturers and front-end controller with supervisor:
  - 1. Honeywell WEBs with Niagara 4.2 Supervisor.
  - 2. Tridium Vykon with Niagara 4.2 Supervisor.
  - 3. Johnson Controls Inc. Facility Explorer, with Niagara 4.2 Supervisor.
  - 4. KMC with Niagara 4.2 Supervisor.
  - 5. No others shall be approved.
- B. All approved TCS equipment shall be purchased through Cochrane Supply of Michigan, 30303 Stephenson Hwy, Madison Heights, MI 48071. (800) 482-4894, or other approved Authorized Building Control Specialist.
- C. Substitutions: Not permitted.
- D. Temperature control system manufacturers must provide a single price to the Mechanical Contractor for temperature control system equipment complete for installation, that shall not include packaging of other HVAC equipment (CRAC, roof top units, etc.).
- E. Requests for substitutions must receive written pre-approved during the bidding period by the Engineer.

### 2.2 GENERAL

- A. The Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall TCS.
- C. Temperature Control System Project Summary:
  - 1. A new stand-alone server or virtual server (provided by the City of Owosso) shall be provided and configured by the Temperature Control Contractor must install a new Tridium Niagara 4 (version 4.2) platform. All new equipment, integration, and programming required for a fully operational platform must be provided by the Temperature Control Contractor.

## 2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open DataTcSe Connectivity (ODBC) or Structured Query Language (SQL) compliant server dataTcSe is required for all system dataTcSe parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary dataTcSe and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
  - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
  - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

## 2.4 TCS SERVER HARDWARE

- A. The Temperature Control Contractor shall coordinate all necessary memory, hard drive, display and network cards, as requested of City of Owosso based on the following:
  - 1. Refer to Tridium Niagara 4.2 Minimum Requirements.
  - 2. Memory: 16 GB or more recommended for the Windows 64-bit version.
  - 3. Hard Drive: 256 GB minimum, more recommended depending on archiving requirements.
  - 4. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
  - 5. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
  - 6. The TCC shall verify the hardware requirements and ensure enhanced TCS hardware performance capabilities are included for robust operation.
- B. The Temperature Control Contractor must include all necessary materials and labor to provide a complete installation of the TCS software.

## 2.5 SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications

between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the TCS, and perform control and operating strategies for the system TCSeD on information from any controller connected to the TCS.

- B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- C. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the TCS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- E. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- F. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
  - 1. BACnet
  - 2. Lon
  - 3. MODBUS
  - 4. SNMP
  - 5. KNX
- G. The SNC shall be capable of executing application control programs to provide:
  - 1. Calendar functions.
  - 2. Scheduling.
  - 3. Trending.
  - 4. Alarm monitoring and routing.
  - 5. Time synchronization.
  - 6. Integration of LonWorks, BACnet, and MODBUS controller data.
  - 7. Network management functions for all SNC, PEC and ASC TCSeD devices.
- H. The SNC shall provide the following hardware features as a minimum:
  - 1. Two 10/100 Mbps Ethernet ports.
  - 2. Two Isolated RS-485 ports with biasing switches.
  - 3. 1 GB RAM
  - 4. 4 GB Flash Total Storage / 2 GB User Storage
  - 5. Wi-Fi (Client or WAP)
  - 6. USB Flash Drive
  - 7. High Speed Field Bus Expansion
  - 8. -20-60°C Ambient Operating Temperature
  - 9. Integrated 24 VAC/DC Global Power Supply
  - 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- I. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- J. The SNC shall provide alarm recognition, storage, routing, management and analysis to

supplement distributed capabilities of equipment or application specific controllers.

- K. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
  - 1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
    - a. Alarm.
    - b. Return to normal.
    - c. To default.
  - 2. Alarms shall be annunciated in any of the following manners as defined by the user:
    - a. Screen message text.
    - b. Email of complete alarm message to multiple recipients.
    - c. Graphics with flashing alarm object(s).
  - 3. The following shall be recorded by the SNC for each alarm (at a minimum):
    - a. Time and date.
    - b. Equipment (air handler #, access way, etc.).
    - c. Acknowledge time, date, and user who issued acknowledgement.
- L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- M. The SNC shall support the following security functions.
  - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
  - 2. Role-TCSed Access Control (RBAC) for managing user roles and permissions.
  - 3. Require users to use strong credentials.
  - 4. Data in Motion and Sensitive Data at Rest be encrypted.
  - 5. LDAP and Kerberos integration of access management.
- N. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
  - 1. Metadata: Descriptive tags to define the structure of properties.
  - 2. Tagging: Process to apply metadata to components
  - 3. Tag Dictionary
- O. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit TCSed upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD...) shall have an associated template file for reuse on future project additions.
- P. The SNC shall be provided with a 5 Year Software Maintenance license. Labor to implement not included.

## 2.6 PROGRAMMABLE EQUIPMENT CONTROLLER (PEC)

- A. All new HVAC control equipment controllers shall be accomplished using Native BACnet TCSed devices. Where the existing application has a LonMark profile or BTL Listed PICS defined, LonMark may be used. Where LonMark devices are not available for a particular application, devices TCSed on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier shall provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and

configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

- B. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
- C. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
- D. The PEC shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the Niagara 4 environment.
- E. The following integral and remote Inputs/Outputs shall be supported per each PEC:
  - 1. Eight integral dry contact digital inputs.
  - 2. Any two digital inputs may be configured as pulse counters with a maximum pulse read rate of 15 Hz.
  - 3. Eight integral analog inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC).
  - 4. Six integral 4-20 ma analog outputs.
  - 5. Eight integral 24 Vac Triac digital outputs, configurable as maintained or floating motor control outputs.
  - 6. One integral 20 Vdc, 65-mA power supply for auxiliary devices.
  - 7. If a 20 Vdc 65-mA power supply terminal is not integral to the PEC, provide at each PEC a separate, fully isolated, enclosed, current limited and regulated UL listed auxiliary power supply for power to auxiliary devices.
- F. Each PEC shall have expansion ability to support additional I/O requirements through the use of remote input/output modules.
- G. PEC Controllers shall support at minimum the following control techniques:
  - 1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
  - 2. General-purpose, non-linear control loops.
  - 3. Start/stop Loops.
  - 4. If/Then/Else logic loops.
  - 5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).

## 2.7 ADVANCED UNITARY CONTROLLER (AUC)

- A. The advanced unitary controller (AUC) platform shall be designed specifically to control HVAC - ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, boilers, PTACs, pumps, fin-tube radiation. The control shall use LonMark or BACnet TCSed devices where the application has a LonMark profile or BTL Listed PICS defined. Where LonMark devices are not available for a particular application, devices TCSed on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier shall provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

- B. Minimum Requirements:
1. The controller shall be fully programmable with full functionality on any Niagara 4 brand platform.
    - a. Support downloads to the controller from any brand of Niagara 4 platform.
    - b. Support uploads from the controller to any brand of Niagara 4 platform.
    - c. Support simulation/debug mode of the controller.
    - d. Maintain native GUI.
    - e. Native function-block programming software and all controller “Setup Wizards” shall be embedded within the Niagara 4 environment.
  2. The controller shall be capable of either integrating with other devices or stand-alone operation.
  3. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications. Controller memory minimum requirements include:
    - a. FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
    - b. FLASH Memory settings retained for ten years.
    - c. RAM: 2 Kilobytes.
  4. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
    - a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
    - b. Accuracy:  $\pm 1$  minute per month at 77 degrees F (25 degrees C).
    - c. Power Failure Backup: 24 hours at 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
  5. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
  6. The controller shall have an internal DC power supply to power external sensors.
    - a. Power Output: 20 VDC  $\pm 10\%$  at 75 mA.
  7. The controller shall have a visual indication (LED) of the status of the device:
    - a. Controller operating normally.
    - b. Controller in process of download.
    - c. Controller in manual mode under control of software tool.
    - d. Controller lost its configuration.
    - e. No power to controller, low voltage, or controller damage.
    - f. Processor and/or controller are not operating.
  8. The minimum controller Environmental ratings.
    - a. Operating Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C).
    - b. Storage Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C).
    - c. Relative Humidity: 5% to 95% non-condensing.
  9. The controller shall have the additional approval requirements, listings, and approvals:
    - a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
    - b. CSA (LR95329-3) Listed.
    - c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
    - d. Meets Canadian standard C108.8 (radiated emissions).

- e. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity).
  - f. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission).
10. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).
  11. The controller shall have a mix of digital inputs (DI), digital Triac outputs (DO), analog outputs (AO), and universal inputs (UI).
    - a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
    - b. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
    - c. Input and Output wiring terminals shall be designated with color coded labels.
    - d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
  12. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
  13. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
    - a. Discharge air control and low limit.
    - b. Pressure-dependent dual duct without flow mixing.
    - c. Variable air volume with return flow tracking.
    - d. Economizer with differential enthalpy.
    - e. Minimum airflow coordinated with CO2.
    - f. Unit ventilator cycle (1, 2, 3) 2-pipe.
    - g. Unit ventilator cycle (1, 2, 3) 2-pipe with face/bypass.
    - h. Unit ventilator cycle (1, 2, 3) 4-pipe.
    - i. Unit ventilator cycle (1, 2, 3) 4-pipe with EOC valve.

## 2.8 OTHER CONTROL SYSTEM HARDWARE

- A. See 23 09 23 Digital Control Equipment for additional control equipment and hardware requirements. This specification section and 23 09 23 shall apply.
- B. Motorized control dampers that will not be integral to the equipment shall be furnished by the Control System Contractor. Control damper frames shall be constructed of galvanized steel, formed into channels and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl or neoprene. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5 inches water gauge static pressure.
- C. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators. Honeywell is TCSis of design.
- D. Control Damper/Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-

open; drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing ' fail-safe' operation shall have spring return to Normal position. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed. Honeywell is TCS basis of design.

- E. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range. Honeywell is TCS basis of design.
- F. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of  $\pm$  0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F(-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range. Honeywell is TCSis of design.
- G. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point. Honeywell is TCSis of design.
- H. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube. Honeywell is TCSis of design.
- I. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips. Honeywell is TCSis of design.
- J. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the TCS in a UL-Certified 508A panel shop. A complete set of ' as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- K. Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of  $\pm$ 1% accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included. Honeywell is TCSis of design.
- L. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13



degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.

- M. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC TCS via built-in interface card (MODBUS or BACnet). Honeywell SmartVFD is TCSis of design.
- N. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub TCSe and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- O. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF."
- P. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.
- Q. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation. Honeywell is TCSis of design.
- R. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

## 2.9 TCS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The TCC Contractor shall provide system software TCS based on server/thin-client architecture, designed around the open standards of web technology. The TCS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the TCS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Window operating systems.
- C. The TCS server software shall support at least the following server platforms (Windows 7, Windows 10). The TCS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a

HTML5 experience that supports the following features as a minimum:

1. Trending.
2. Scheduling.
3. Electrical demand limiting.
4. Duty Cycling.
5. Downloading Memory to field devices.
6. Real time 'live' Graphic Programs.
7. Tree Navigation.
8. Parameter change of properties.
9. Set point adjustments.
10. Alarm / event information.
11. Configuration of operators.
12. Execution of global commands.
13. Add, delete, and modify graphics and displayed data.

- E. Software Components: All software shall be the most current version. All software components of the TCS system software shall be provided and installed as part of this project. TCS software components shall include:
1. Server Software, DataTCSe and Web Browser Graphical User Interface.
  2. 5 Year Software Maintenance license. Labor to implement not included.
  3. Embedded System Configuration Utilities for future modifications to the system and controllers.
  4. Embedded Graphical Programming Tools.
  5. Embedded Direct Digital Control software.
  6. Embedded Application Software.
- F. TCS Server DataTCSe: The TCS server software shall utilize a Java DataTCSe Connectivity (JDBC) compatible dataTCSe such as: MS SQL 8.0, Oracle 8i or IBM DB2. TCS systems written to Non -Standard and/or Proprietary dataTCSeS are NOT acceptable.
- G. Thin Client - Web Browser TCSeD: The GUI shall be thin client or browser TCSeD and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
  2. Secure Socket Layers: Communication between the Web Browser GUI and TCS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

## 2.10 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address,

the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-TCSed application control privileges.

- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
  2. Groups View shall display Scheduled Groups and custom reports.
  3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
  2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
  3. Search: User shall have multiple options for searching data TCSed upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
  4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
  5. Schedules: Shall be used to create, modify/edit and view schedules TCSed on the systems hierarchy (using the navigation tree).
  6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
  7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
  8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
  9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
  10. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance

usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following TCSic criteria:

11. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
  12. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
  13. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
  14. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
  15. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
    - a. Each piece of equipment monitored or controlled including each terminal unit.
    - b. Each building.
    - c. Each floor and zone controlled.
- E. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled TCSed on:
    - a. Types of schedule shall be Normal, Holiday or Override.
    - b. A specific date.
    - c. A range of dates.
    - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
    - e. Wildcard (example, allow combinations like second Tuesday of every month).
  2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
  3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
  4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn

on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.

5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
  6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- F. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
  2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
  3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
  4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
  5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
  6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
  7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the TCS Server dataTCSe.
  8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the dataTCSe and archived to a text file after an operator defined period.
  9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the TCS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
    - a. Print: Alarm information shall be printed to the TCS server's PC or a networked printer.

- b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
  - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
  - d. Write Property: The write property reporting action updates a property value in a hardware module.
  - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
  - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- G. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
  2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the TCS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
  3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
  4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
  5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
  6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
  7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- H. Security Access: Systems that are accessed from the web browser GUI to TCS server shall require a Login Name and Strong Password. Access to different areas of the TCS system shall be defined in terms of Role-TCSed Access Control privileges as specified:
1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
    - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
    - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.

- c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

## 2.11 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
  1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
  2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
  3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
  4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
  5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
  6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.

7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

## 2.12 LONWORKS NETWORK MANAGEMENT

- A. BACnet shall be the primary protocol used. Systems requiring the use of third-party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management dataTCSe.
- E. The network management dataTCSe shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management dataTCSe at all times. Systems employing network management dataTCSeS that are not resident, at all times and within the control system shall not be accepted.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. The temperature control contractor shall coordinate all work with the City of Saginaw Technical Services (IT) Department. Coordinate requirement for virtual network, IP addresses, and VPN.



TCC shall provide all requested hardware, firmware, software, and programming requested by the Owner.

### 3.3 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

### 3.4 WIRING

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

### 3.5 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a

point-by-point log to validate 100% of the input and output points of the DDC system operation.

- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.
- D. The Third-party temperature control system commissioning agent will provide a written commissioning report.
- E. The TCC shall provide all necessary labor and materials required to meet the recommendations of the commissioning agent prior to system acceptance, project close-out, and release of retainage.
- F. Final written acceptance of the TCS shall be provided by the Owner.

### 3.6 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide 4 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

### 3.7 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the TCS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 5 Year Software Maintenance license. All SNC and TCS Servers are included in this coverage. Labor to implement upgrades in years two through five are not included in standard warranty.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning

correctly.

- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

### 3.8 WARRANTY ACCESS

- A. The Owner shall grant to the Temperature Control System Contractor reasonable access to the TCS during the warranty period. Remote access to the TCS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) may be allowed.

### 3.9 OPERATION & MAINTENANCE MANUALS

- A. See General Requirements. O&M manuals shall include the following elements, as a minimum:
  1. As-built control drawings for all equipment.
  2. As-built Network Communications Diagram.
  3. General description and specifications for all components.
  4. Completed Performance Verification sheets.
  5. Completed Controller Checkout/Calibration Sheets.

### 3.10 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## SECTION 23 09 23

### TEMPERATURE CONTROL EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. System Architecture
  - 1. Provide as many equipment controllers and control points necessary to achieve the required control and monitoring functions.
  - 2. Each installation shall comply with local, state, and federal code requirements as applicable.
- B. Operating Environment
  - 1. Ambient temperature: 32-110 degrees F.
  - 2. Relative humidity: 10-90% non condensing.
  - 3. Electrical supply: +/-10% of mains power.
- C. Sequence of Operations is included with this Section.

##### 1.2 QUALITY ASSURANCE

- A. All materials used in this work shall be new, of the latest make/model currently in production and they shall be compatible with current server software version and of a type specifically manufactured for the use intended.
- B. Design Criteria
  - 1. The control system shall include all devices and wiring necessary to bring all building systems under control as specified herein and/or as shown on the Drawings.
  - 2. See Mechanical Drawings and Sequence of Operations.
- C. Uniformity and Supply
  - 1. Provide a system of consistent architecture and control philosophy, with similar components of uniform manufacture. Provide Control Units from a single manufacturer.
  - 2. Workstation hardware: May be sourced from a manufacturer other than the FMS supplier.
- D. Standards and Codes
  - 1. Only use system components that are UL listed, CE compliant for Electromagnetic Compatibility (EMC) and comply with FCC Part-15 as applicable.

##### 1.3 MANUFACTURERS

Contact Engineer Andrew Farron at Spicer Group ([andrew.farron@spicergroup.com](mailto:andrew.farron@spicergroup.com)) for approved equals or voluntary alternate. Must receive approval prior to bidding.

- A. Control Dampers:
  - 1. Ruskin
  - 2. Greenheck
  - 3. Contact Engineer for other Approved Equals or Voluntary Alternates.
- C. Wall Thermostats
  - 1. Honeywell
  - 2. KMC
  - 3. JCI
  - 4. All others by Voluntary Alternate.

## 1.4 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of the Bid Date, and any subsections thereof as applicable, shall govern the design of equipment and materials supplied.
  - 1. UL 916 – Underwriters Laboratories Standard for Energy Management Equipment.
  - 2. NEC – National Electrical Code
  - 3. BACnet – ASHRAE Standard 135

## 1.5 SUBMITTALS

- A. General
  - 1. See 23 00 00 Mechanical General Provisions for Submittal requirements.
- C. Damper Selection
  - 1. If applicable: Submittals must include leakage, maximum airflow and maximum pressure ratings based on AMCA Publication 500. Dampers shall meet the leakage requirements of the International Energy Conservation Code by leaking less than 3 cfm/sq. ft. at 1" of static pressure and shall be AMCA licensed as Class 1A. Dampers shall be Ruskin model CD60.
- D. Manuals
  - 1. See 23 00 00 Mechanical General Conditions for manual requirements. Include the following:
    - a. Updated functional specification.
    - b. Specification sheets and technical brochures on all equipment.
    - c. Listings and description of application programs.
    - d. Programmer's manual.
    - e. Operator's manual including schedules of alarms, parameters, status, analog indicators, etc,
    - f. Circuit diagrams.
    - g. Drawings.
  - 2. Final submission: Within one week prior to date of Substantial Completion, provide three (3) sets of manuals.
  - 3. Final payment and project close-out shall not take place without the submission of manuals.

## PART 2 – PRODUCTS

Only products required for this project apply.

### 2.1 CONTROL DAMPERS

- A. General: Furnish and install, at locations shown on plans, or in accordance with schedules, control dampers manufactured by an ISO 9001 accredited manufacturer that meet the following minimum construction requirements.
- B. Damper Frames: Damper frames (when size permits) shall be constructed of roll-formed structural hat channels, reinforced at the corners, formed from a single piece of minimum 16 gauge (1.6) galvanized steel. The roll-formed frames shall be structurally superior to 13 gage U-channel frames.
- C. Damper Blades Configurations:

Opposed Blade Dampers are required for all proportional airflow inlet or outlets or for standard 2-position operation.

Parallel Blade Dampers may be used for 2-position, open-closed, applications only.

- D. Damper blades shall be airfoil type for superior pressure drop performance and low noise generation. They shall be formed from a single piece of galvanized steel through a 20-stage roll-form process and shall be equivalent to other type blades constructed from 14 gauge (2.0) galvanized steel. Blade edge seals shall be flexible and suitable for -72°F (-60°C) to +275°F (+135°C) mechanically locked into the blade edge yet easily replaceable in the field.
- E. Jamb Seals: Jamb seals shall be flexible stainless steel, compression type to prevent leakage between the end of the blade and the damper frame. Use of the blade end to overlap the frame for a jamb seal is not acceptable. Adhesive or clip-on type seals for blade and jamb seals are not acceptable.
- F. Bearings shall be corrosion resistant, permanently lubricated stainless steel sleeve type turning in an extruded hole in the damper frame. Axles shall be ½” (13) plated steel, hexagon shaped and positively locked into the damper blades (round axles are not acceptable).
- G. Linkage: Linkage shall be concealed out of airstream, within the damper frame to reduce pressure drop, noise and maintenance.
- H. Approved Models: Ruskin CD60 or equal.

## 2.2 ACTUATORS

### A. Actuators

- 1. All electronic actuators shall be sized according to the manufacturer’s recommendations for the applications described on the drawings and/or specifications.
  - a. Proportional
    - 1) High resolution electronic actuator
    - 2) Current limiting circuitry.
    - 3) 2-10 VDC control signal or 3-point floating control.
    - 4) 24 VAC control power.
    - 5) Position feedback (tied into an analog input on the associated controller).
  - b. Two-position electronic
    - 24 VAC control power.
- 2. Electro-thermal actuators are not acceptable.
- 3. Actuators shall be equipped with manual positioner (hand wheel or lever) to allow for manual positioning in the absence of control power.
- 4. Wiring to control valve actuators
  - a. Factory installed pigtails on valve actuators may be installed exposed (no conduit). Splices to the pigtail shall be within a splice box and all wiring from that point shall be within conduit.
  - b. If no factory installed pigtails are provided, field installed SO cord (plenum rated) may be used up to two feet in length from the terminals on the valve actuator to a splice box. Provide strain relief on each end of the SO cord.
- 5. Manufacturers: Belimo, Honeywell.

## 2.3 CONTROLLERS

- A. Supervisory Logic Controller (or Building Controller as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)

1. For the purposes of this Specification, a Supervisory Logic Controller contains the primary supervisory logic programming, sequences and global strategies as needed for complete control of all units connected to the building sub-network as described in this specification and the Contract Drawings.
  2. In the event of a loss of communication, the Supervisory Logic Controllers shall, as defined in the supervisory software:
    - a. Retain and control to the last downloaded setpoints or default to pre-determined setpoints and/or each individual output to a predetermined value (analog) or state (binary).
    - b. Retain the last downloaded value or default to a pre-determined value all Analog Values or Binary Values whose calculation is based on a value transferred from another building system.
  3. ANSI/ASHRAE Standard 135-1995, including current Addenda, BACnet, shall be used as the communication protocol to other controllers on the building sub-network.
  4. The Supervisory Logic Controller shall, as a minimum, support the following Objects:
    - a. Binary Input
    - b. Binary Output
    - c. Binary Value
    - d. Analog Input
    - e. Analog Output
    - f. Analog Value
    - g. Calendar
    - h. Schedules
    - i. Loop
    - j. Program
  5. The Supervisory Logic Controller shall:
    - a. Utilize its own 32-bit processor.
    - b. Contain sufficient memory to support its database and programming requirements with non-volatile memory capable of preserving it's programming for a minimum of one year.
    - c. Be fully programmable from any Central Site Workstation or locally from a laptop PC.
    - d. Contain an on-board, battery backed Calendar Clock.
  6. If the Supervisory Logic Controller has the capability of accepting hardware I/O, it:
    - a. Shall utilize universal inputs, which will accept 10K thermistors, 0-5VDC, 0-10VDC, 4-20 MA or dry contact signals with a minimum 12 bit A to D conversion of all Analog inputs. LED's indicating input status shall be provided.
    - b. Shall utilize 0-10VDC with a minimum 10 bit D to A conversion of all Analog Outputs.
    - c. Shall be capable of multiple PID loops for control of multiple outputs.
    - d. Shall provide the following for all outputs:
      - 1) Hand-Off-Auto selector switch for all outputs.
      - 2) Potentiometer-style control of the output signal though the entire range with the capability of leaving the output at any point in the range.
      - 3) LED's indicating status for all outputs.
    - e. May monitor and control all primary heating, cooling and multi-zone air handling equipment.
- B. General Purpose Stand-alone Controller (or Advanced Application Controller as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
1. For the purposes of this Specification, a General Purpose Stand-alone Controller:

- a. Resides on the building sub-network.
  - b. May contain some of the sequences and strategies as needed for complete control of all units connected to the building sub-network.
  - c. Shall utilize its own 64-bit (or 32-bit if required) processor.
  - d. Shall utilize universal inputs, which will accept 10K thermistors, 0-5VDC, 0-10VDC, 4-20 MA or dry contact signals, and have minimum 12 bit A to D conversion of all Analog inputs.
    - 1) LED's indicating input status shall be provided.
  - e. Shall utilize 0-10VDC with a minimum 10 bit D to A conversion of all Analog Outputs.
  - f. Shall contain sufficient memory to support its database and programming requirements with non-volatile memory capable of preserving it's programming for a minimum of 1 year.
  - g. Shall be capable of multiple PID loops for control of multiple outputs.
  - h. Shall provide the following for all outputs:
    - 1) Hand-Off-Auto selector switch for all outputs.
    - 2) Potentiometer style control of the output signal though the entire range with the capability of leaving the output at any point in the range.
    - 3) LED's indicating status for all outputs.
  - i. Shall be fully programmable from any Central Site Workstation or locally from a laptop PC.
  - j. The General Purpose Stand-alone Controller may monitor and control primary heating, cooling and multi-zone air handling equipment.
2. In the event of a loss of communication, the General Purpose Stand-alone Controllers shall, as defined by the supervisory software:
- a. Retain and control to the last downloaded setpoints or default to pre-determined setpoints, and/or control each individual output to a pre-determined value (analog or state (binary)).
  - b. Retain the last downloaded value or default to a pre-determined value all Analog Values or Binary Values whose calculation is based on a value transferred from another building system.
3. Shall use ANSI/ASHRAE Standard 135-1995, including current Addenda, BACnet as the communication protocol to other controllers on the building sub-network. Protocol shall be MSTP.
4. The General Purpose Stand-alone Controller shall, as a minimum, support the following Objects:
- a. Binary Input
  - b. Binary Output
  - c. Binary Value
  - d. Analog Input
  - e. Analog Output
  - f. Analog Value
  - g. Calendar
  - h. Schedules
  - i. Loop
- C. Unitary or Terminal Unit Controller (or Application Specific Controller as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
1. For the purposes of this Specification, a Unitary or Terminal Unit Controller:
- a. Resides on the building sub-network.
  - b. Shall be a stand-alone controller.



- c. Shall be capable of multiple PID loops for control of multiple outputs.
- d. Shall utilize its own 32-bit processor.
- e. Shall provide at least 3 universal inputs, which will accept 10K thermistors, 0-5VDC, 0-10VDC, 4-20 MA or dry contact signals. And have minimum 10 bit A to D conversion of all Analog inputs.
  - 1) Exception: When used as a VAV terminal unit controller, one input may be dedicated to an on-board flow transducer.
- f. Shall provide at least one Analog output utilizing a 0-10VDC signal with a minimum 8 bit D to A conversion.
- g. Shall provide at least two Binary Outputs.
- h. Shall contain sufficient memory to support its database and programming requirements with non-volatile flashable memory.
- i. Shall be capable of PID loop control.
- j. Be fully programmable from any Central Site Workstation, a supervisory logic controller or locally from a laptop PC.
  - 1) Pre-configured, downloadable software routines for control of the more common unitary hardware configurations shall be provided.
  - 2) Custom software routines may be defined and downloaded as required.
- k. The Unitary or Terminal Unit Controller shall not be used to control any primary heating, cooling or multi-zone air handling equipment.
- l. A communications jack shall be installed in the zone and connected to the Unitary or Terminal Unit Controller that is controlling that zone.
  - 1) The communications jack shall be integral to the temperature sensor where one is provided in the zone.
  - 2) If a zone temperature sensor is not required for a particular terminal unit or unitary controller a communications jack shall be installed in the zone at an accessible location (within 5 ft. of floor).
- 2. The ANSI/ASHRAE Standard 135-1995, including current Addenda, BACnet shall be used as the communication protocol to other controllers on the building sub-network. Protocol shall be MSTP.
- 3. In the event of a loss of communication, the Unitary or Terminal Unit Controllers shall, as defined by the supervisory software:
  - A. Retain and control to the last downloaded setpoint or default to pre-determined set point.
  - B. Retain its last downloaded control mode or default to a pre-determined control mode.
- 4. The Unitary or Terminal Unit Controller shall, as a minimum, support the following Objects:
  - a. Binary Input
  - b. Binary Output
  - c. Analog Input
  - d. Analog Output

## 2.4 INPUT DEVICES

- A. Room Temperature Sensor (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
  - 1. 10K ohm @ 77 deg. F. thermistor, +/- .36 deg. F. accuracy over 32 to 96 deg. F. range.

2. Except where noted, all room sensors shall have an LCD display for viewing room temperature, room temperature set point and outside air temperature. All of these points, including set point adjustment, shall be able to be disabled through software.
  3. Must include programmable temperature adjustment range, and over-ride functionality.
  4. Where noted, use a blank tamperproof cover, with sensor and integral communications jack to communicate with the zones unitary controller.
  5. Install 5' above finished floor unless otherwise indicated.
- B. Duct Temperature Sensor (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
1. 10K ohm @ 77 deg. F. thermistor, +/- .36 deg. F. accuracy over 32 to 158 deg. F. range.
  2. Locate in the main air stream as close to the center of flow as is possible.
- C. Immersion Temperature Sensor (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
1. 10K ohm @ 77 deg. F. thermistor, +/- .36 deg. F. accuracy over 32 to 158 deg. F. range.
  2. Provide stainless steel or brass thermowell for threaded mounting into pipe.
  3. Thermal paste shall be used in all thermowells.
- D. Outside Air Temperature (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
1. 10K ohm @ 77 deg. F. thermistor, +/- .36 deg. F. accuracy over -40 to 150 deg. F. range.
  2. Install away from exhaust/relief vents. Preference should be given to locate as near as possible to the outside air intake for the air handling equipment which it shall help to control, but keeping it out of direct sunlight or other sources of influence which would adversely affect it's accuracy. When possible the sensor should be located on the northwest outside building wall.
  3. Outside air temperature sensors shall not be mounted within the intake air plenum or ductwork.
- E. Humidity Sensor (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
1. 0% to 100% RH range, +/- 3% accuracy. Applies to duct or space sensors. Space sensors shall be incorporated in the same housing as the zone or room temperature sensor where available.
- F. Current Operated Switches (Fan and Pump status)
1. Kele & Assoc. PD75 series, Veris Ind. Hawkeye 705, or approved equal.
  2. Adjust to detect belt or coupling breakage under minimum flow conditions.
  3. An alternate device for a status input, which is tied to a digital output, may be an analog type current transformer if the system hardware/software accepts this type of proof.
- G. Air Pressure Differential Analog Sensor (Filter status).
1. Mamac Systems model PR-274-R3-VDC (see H.5 below)

- H. Static Pressure Transducers
  - 1. Mamac Systems
  - 2. 24 VAC supply
  - 3. 0-5 VDC – Output
  - 4. Model PR-274-R2-VDC for building/room differential pressure control (-0.25” to +0.25” Wg )
  - 5. Model PR-274-R3-VDC for Duct static pressure (0" to 5" Wg, or as indicated on the Drawings).
  
- I. Air velocity
  - 1. Atkinson Electronics PACM//02S Programmable Analog Control Module with SVP velocity probe, or approved equal.
  
- J. Carbon Dioxide (CO2) Sensors
  - 1. Teleair, Honeywell, KMC
  - 2. 24 VAC supply
  - 3. 0-5 VDC – Output
  - 4. Model PR-274-R2-VDC for building/room differential pressure control (-0.25” to +0.25” WG)
  - 5. Model PR-274-R3-VDC for Duct static pressure (0” to 5” Wg, or as Indicated on the Drawings).

## 2.5 RELAYS

- A. 8-Pin, octal base, DPDT, with manual push-button operator and integral indicator light.
  - 1. Exception: specialty relays such as time delay or interval timers which may be: 11-pin, SPDT, need not have manual operators or indicator lights.
  
- B. Matching socket snap-mounted on standard DIN-rail.

## 2.6 ENCLOSURES

- A. General
  - 1. All controllers, power supplies and relays shall be mounted in enclosures.
  - 2. Enclosures may be NEMA 1 when located in a clean dry indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean dry environment.
  - 3. Enclosures shall have hinged, latching doors.
  
- B. Enclosures for Supervisory or General Purpose Controllers in Mechanical Spaces:
  - 1. A gutter (minimum 6”x6”x6”) shall be furnished and installed directly beneath or above each controls enclosure by the Controls Contractor. All home runs (control, signal and communication) shall enter this gutter. Wiring shall then be routed from the gutter through minimum 1” conduits to each of the controls enclosures. All circuits in the gutter and controls enclosure shall be Class II or III (as defined by NEC).
    - a. Power Supplies, transformers or other devices requiring 110 VAC (or greater) power shall be mounted in a separate enclosure. A sign warning of the presence of High Voltage inside shall be placed on the door.

2. Analog input cables shall be in separate raceways from all other control wiring from the gutter mounted beneath Controls enclosure to the input device.  
Exception: power supply wiring for powering field mounted analog input transducers.
  3. See Part 4 Details for installation diagram.
- C. Controls enclosures for Terminal Units:
1. Enclosures shall be NEMA 1 and shall be integral to the controller where possible. Terminal unit controllers without integral enclosures may be mounted directly to 4-square boxes where designed to do so, but in no case shall controllers be mounted directly to the terminal unit or lack the provision for concealed connection of all wiring terminations.
  2. ½" Flex (minimum) from the power supply mounted within 2 feet of the terminal unit and ½" flex (minimum) from the I/O & Communications 4-square box mounted within 2 feet of the terminal unit shall terminate at this enclosure.
  3. No open wires shall be allowed at the terminal unit.
    - a. Exception: Pigtail cabling to damper operators and/or valve actuators.
- D. Enclosures for Smoke Exhaust Fan Variable Frequency Drives:
1. To ensure VFD frequency / and SEF airflow is not accidentally adjusted after final commissioning, each smoke exhaust fan VFD shall be installed in locking cabinet.
  2. Provide a total of (6) VFD cabinets labeled as SEF-XXXX VFD.
  3. Provide (2) copies of keys, one to be kept in the Master Control Room, and one to be given to the City of Saginaw.

## 2.7 MONITOR AND CONTROL POINTS

- A. Provide all analog, binary, and digital sensors and control devices as specified and required for a complete and working temperature control system. The installation of such devices and sensors shall be the responsibility of the Contractor. Contractor shall also provide all required auxiliary contacts, relays, transformers, transducers, resistors, etc. to perform the monitoring of control functions specified. Sensors and their connections shall be electronic or electric.
- B. Where, due to the size of the damper or coil, multiple damper operators or control valves are specified, the control for this combination of actuators and valve operators shall be specified as one control point. The contractor shall provide all wiring, tubing, and relays to operate these control devices as one unit.
- C. Not all control points listed below shall specifically apply to this project. Field verify the requirement for each.
- D. Control Point Type

General: The Contractor shall provide the current industry standard equivalent control point to those listed below and that which interfaces and integrates with the new Temperature Control System.

1. Temperature (Analog Input)
  - a. Space Temperature: Sensor installed in wall-mounted tamperproof enclosure with locking covers. Since aesthetics are of the highest concern with all visible elements, sensor enclosure must be kept as unobtrusive as possible. All enclosures are subject to approval of the Architect, submit samples.
  - b. Return Air Temperature: Upstream of outside air connection.

- c. Mixed Air Temperature: Provide averaging type sensor.
- d. Coil Discharge: Downstream of coil in unit casing. Where coils are installed within same unit casing and distance between coils is minimal, use averaging type sensors mounted off coil face.
- e. Outside Temperature: Provide rainproof enclosure and solar shielding. Sensor to be located on roof or on side of bulkhead. Submit locations for approval by A/E.
- 2. Relative Humidity (Analog Input)
  - a. Outside Relative Humidity: Provide rainproof enclosure and solar shielding. Sensor to be located on roof or on side of bulkhead. Submit location for approval by A/E.
  - b. Space Relative Humidity: Sensor installed in wall-mounted tamper proof enclosure. Since aesthetics are of the highest concern with all visible elements, sensor enclosures must be kept as unobtrusive as possible. All enclosures are subject to approval of the Architects, submit samples.
- 3. Fan Status (Analog Input)
  - a. Provide current transducer (CT) for each fan to indicate Fan motor load. Calibrate CT with software to indicate normal operation, broken belt, and overload.
  - b. CT shall also be used to sense “single phasing” power failure and automatically shutdown affected fan.
  - c. (Digital Point) Where indicated provide differential pressure switch across the fan.
- 4. Exhaust Fans Status (Digital Input)
  - a. Duct or Plenum Mounted Fans: Provide differential pressure switch across fans.
  - b. Mushroom Type Fan: Provide sail switch in ductwork upstream of fan.
  - c. Provide auxiliary contacts and relays to monitor fan starter status to determine if fan is required to be on.
- 5. Pump Status (Digital Input)
  - a. Provide differential pressure switch across pump to prove flow.
- 6. Filter Alarm (Analog Input)
  - a. Provide differential pressure sensor with sensing element across each filter in the filter bank. Indication shall be by means of software as differential pressure rises above a preset adjustable setpoint. Utilize variable capacitance sensor with 4-20 MA transmitter. Accuracy including non-linearity hysteresis and non-repeatability is within 1% of full scale.
- 7. Contact Closure (Digital Input)
  - a. Provide control relays and auxiliary contacts to monitor the following:
  - b. Equipment status or summary alarm.
  - c. Operating mode and ready.
  - d. Freezestat.
  - e. Damper end switch. For each air handling system, damper end switches shall be annunciated at a local panel. A summary alarm for each shall be annunciated at the BAS.
  - f. Smoke damper end switches. End switches for these dampers must be annunciated individually.
  - g. Single phase alarm. Contact closure from motor control center to indicate loss of phase leg. Upon sensing alarm, BAS shall shut down all equipment associated with that motor control center.
- 8. Pressure Sensor (Analog Input)
  - a. Provide pressure sensor in piping.
- 9. Carbon Dioxide Sensor (Analog Point)
  - a. Provide carbon dioxide sensors located adjacent to space thermostat.

E. Control Points

1. Start/Stop or Enable Disable (Digital Output Point)
  - a. Start/Stop relay module shall contain two (2) single pole, double-throw relays for start/stop functions at the remote point, with both relays mounted on a circuit board and factory wired to numbered terminal strips.
  - b. Where multiple relays are required for a single start/stop point, Contractor shall furnish and install all relays and necessary controls interface.
  - c. Where an Enable/Disable point is called for, connect to equipment controls to maintain all normal start up and shut down sequences, interlocks, and safeties.
2. Damper Control-Modulating (Analog Output)
  - a. DCP shall be in direct digital control of damper positions to affect the specified sequences of operation.
  - b. Dampers on units with CO2 sensors in the return air shall be of the modulating type.
3. Damper Control - 2 Position (Digital Output)
  - a. DCP shall be in direct digital control of minimum outside return air or make up air dampers.
4. Control Valve - Modulating (Analog Output)
  - a. DCP shall be in direct digital control of heating and cooling, control valves to affect the specified sequence of operation.
5. Control Valve - 2 Position (Digital Output)
  - a. DCP shall be in direct digital control of valve position.
6. Control Mode Selector (Digital Output)
  - a. DCP shall be in direct digital control of selector switch to index equipment to various modes of operation. See Sequence of Operation.
7. Reset Signal (Analog Output)
  - a. DCP shall send output signal to reset port of equipment control panel.
  - b. Reset shall include chilled water temperature.
  - c. BAS contractor shall coordinate with equipment manufacturer as to the proper reset signal (4-20 ma, 0-10 vdc, etc.).
8. Carbon Dioxide Sensors (Demand Control CO2 Ventilation)
  - a. Carbon dioxide sensing cell shall consist of a nondispersive infrared carbon dioxide gas cell that uses a pulsed source and has no free air optical path. Output shall be linearized 4-20 Ma with the 24 VDC input. In addition, the unit shall be capable of providing SPDT switching of an external low voltage circuit at an adjustable setpoint. The unit shall be specifically designed for the wall or duct application specified. Return air aspiration boxes shall be designed by and approved by the manufacturer. Unit shall have single point setpoint and span adjustment. The unit shall have no moving parts.
  - b. Power for the sensor shall be extended from a transformer or adaptor installed adjacent to the DDC control panel, and shall be run parallel to the 4-20 Ma signal cable.
  - c. Minimum requirements:
 

1) Range	0-2,000 ppm
2) Accuracy	3% full scale
3) Repeatability	1% of full scale
4) Power Consumption	< 3 watts
5) Relay contact rating	1 amp @ 28 VDC
6) Drift	Zero Drift at 100 ppm per 24 hours (random, not cumulative).
7) Maximum allowable drift in 1 yr	100ppm
  - d. Contractor shall provide all necessary equipment and test gas for calibration and shall calibrate all CO2 sensors in accordance with the manufacturers' recommendations.

## 2.8 WALL THERMOSTATS AND SENSORS

### A. Adjustable Thermostats

1. Where shown on plans provide digital programmable thermostat.
  - a. The thermostat shall include backlit LCD display and temperature display.
  - b. Adjustable temperature (+/- 3 deg. F (adj.), and when adjusting over-ride function. Adjustable temperature range shall be controlled through TCS.
  - c. Thermostats shall be interconnect to the TCS.
  - d. Provide heavy duty, polycarbonate, tamper-proof, keyed thermostat covers where noted on plans.

### B. Sensors

1. Where shown on plans provide temperature sensors only. Controlled through the TCS.

## 2.9 ASSOCIATED EQUIPMENT

### B. Local and Auxiliary Control Panels

1. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
2. ANSI/NEMA 250, general-purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
3. Panels shall be sized for a maximum fill of 60% capacity.

### C. Duct Pressure Probes

1. Duct static pressure probe shall be capable of static pressure measurement with bi-directional flow in a duct, plenum or air handling unit. Probe shall have minimum 4" insertion depth, shall compensate for total pressure error, and shall provide an accurate, repeatable and stable static pressure value with a maximum flow of 4000 fpm.
2. Probe shall be constructed of aluminum, with mounting flange suitable for round or flat duct surfaces. Probe shall have static pressure signal fitting.
3. The duct pressure transmitter will be located near end of supply duct main common to an area requiring the most to satisfy air delivery.

- H. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

## PART 3 - EXECUTION

### 3.1 ELECTRICAL WIRING

- A. Provide all control wiring under this Section regardless of voltage. All control wiring shall be installed under the direct control and supervision of the Control Contractor. Provide wiring for all control devices specified herein, shown on drawings, or supplied with specified mechanical equipment.
- B. Provide interlock wiring.
- C. Provide all other wiring required for the complete cooperation of the specified systems including required transformers.
- D. Run control wiring in conduit where exposed lower than 8' above floor. Conduit shall comply with the requirements of the Electrical Specification.

### 3.2 WIRE AND CABLE

- A. Wire and cable connection for the system shall be as follows:
  - 1. All wiring shall be selected and installed per controller manufacturer installation instructions or per industry standards.
  - 2. Provide plenum rated cabling that runs through return air plenums. Field verify locations.
- B. Wiring shall be in accordance with the requirements of Division 26, 27, & 28.
  - 1. All wire, cables and control transformers shall be furnished and installed by the Controls Contractor. Includes interlock wiring required to provide a complete, operational control system. Exception: Power wiring for smoke dampers furnished under this Section shall be as specified in Section 16721.
  - 2. All analog input wiring shall be twisted pair cabling.
    - b. Exception: Field mounted transducers that require separate power supply may use multi-conductor cabling.
  - 3. All other I/O and power supply wiring shall be 18 AWG (minimum) TFFN, unless specifically required by the system manufacturer and approved by the Engineer for each specific installation.
  - 4. All signal and low voltage control wiring shall be stranded wire. No solid core wire. All low voltage wire and control wire shall be installed in raceways unless noted otherwise.
  - 5. All control wiring shall be labeled at each end, including spares.
    - a. Labeling shall be identified on As-built drawings.
    - b. Labels shall be self-laminating vinyl film or approved equal.
    - c. No hand written labels. Labeler printed only.
  - 6. Allow for a minimum of 12" of slack in all wiring as it passes through the gutter mounted beneath the controls enclosures in the mechanical spaces.
  - 7. Splices shall not be allowed.
  - 8. All digital input, analog input, analog output and pulse-counter signals shall be isolated from earth ground (floating).
  - 9. Where raceway is attached to equipment, provide ample flexible conduit to permit normal machinery movement.
  - 10. "Across-the-hinge" wiring shall be dressed to avoid strain and abrasion. Provide spiral wrap suitable to this application.
- C. Temperature Control System Network Communications Wiring:
  - 1. Wire shall be of type as specified by Control System Manufacturer. If manufacturer has no requirement, then minimum quality of communication wire installed shall be equal to 24 gage Cat 6 shielded, plenum-rated (if installed in return air plenums – see plans for RA plenum locations).



2. Wiring shall be in a separate raceway from all other wiring (except as noted elsewhere) from the gutter mounted above or below the controls enclosure in the mechanical space to the tie point.
    - a. Allow 12" of slack in the gutter.
    - b. There shall be no splices in Communications wiring.
    - c. Coordinate installation of the data/voice jack (in close proximity to the Supervisory Controller or General Purpose Standalone Controller) in each mechanical space.
- D. Terminal Unit Wiring.
1. Supply power:
    - a. 110 VAC power shall be run to each transformer location. Coordinate with Division 16 Contractor.
    - b. 110 VAC x 24 VAC transformers (100 VA maximum, 40 VA minimum), supplied and installed by Controls Contractor shall be located within 2 feet of the terminal unit.
    - c. 24 VAC shall be Class II circuit.
    - d. 24 VAC supply power shall be fused at 4 amps maximum. Fuse shall be accessible without having to remove any covers.
    - e. Flex conduit is to be used between the transformer and the terminal unit controller enclosure.
  2. Other wiring:
    - a. Sub-Network Communication and room sensor/auxiliary I/O wiring shall be run in separate conduits to a single 4" square J-Box (separate from supply power) mounted to the structure within 2 feet of the terminal unit. Flex conduit is to be used between this J-box on the structure and the terminal unit controller enclosure. Sub-Network Communication, room sensor and auxiliary I/O wiring may be combined in the flex to the terminal unit controller enclosure.
    - b. Communications wiring may also be combined with other I/O wiring in the gutter mounted beneath the controls enclosure in the mechanical space only. All other communications wiring shall be in a separate raceway.

### 3.3 INSTALLATION

- A. Install the system as recommended by the manufacturer, using only equipment recommended or acceptable to the manufacturer.
- B. Comply with the State and Local Electrical Code for electrical work. Run all wiring in exposed areas in conduit. Run all wiring in finished spaces concealed. All equipment located outside shall be in suitable weather tight enclosure.
- C. Install all conduit, wiring, and cable, and install all equipment in first-class manner, using proper tools, equipment, hangers, and supports, and in locations as required for a neat, attractive installation. No material shall be exposed if it is possible to conceal it. Exposed materials shall be installed only with consent of the engineer.
- D. Raceways to all control devices shall conform to the requirements of 2017 NEC.
  1. Layout of raceways shall be as shown on the Contract Drawings and/or specified herein.
  2. Layout of communications raceways shall be installed per the manufacturers' recommendations.
  3. Layout for I/O raceways on air handling units generally require three 4" sq. boxes for analog inputs (one at each end of the AHU and one at the mixed air plenum), and three 4" sq. boxes for all other I/O (one at each end of the AHU and one at the mixed air plenum). Provide additional boxes and raceway so that final wire fill does not exceed 60% of total

- available capacity. All wiring in mechanical rooms to be in raceway with sufficient j-boxes, flex, etc. to allow for connection to all devices without exposed wiring.
4. Minimum conduit size to be ¾”.
  5. It shall be the responsibility of the Controls Contractor to review the Contract Documents to confirm that the designated layout is correct for their hardware and conduit sizing (¾” minimum) is sufficient to all devices.
  6. Any required changes shall be noted in a timely manor to allow for any changes prior to rough-in of other conduit in order to make for a complete and orderly installation with minimized cross-overs or other conflicts.
- E. Support all sensors as recommended by the manufacturer where inside equipment such as ductwork. Sensors in the space shall be in small, attractive housings designed for that purpose and mounted on an electrical junction box.
- F. Control Damper Installation:
1. Install dampers at locations indicated on the drawings and in accordance with manufacturer's installation instructions.
  2. Install dampers square and free from racking with blades running horizontally or vertically as required.
  3. Do not compress or stretch damper frame into duct or opening.
  4. Handle damper using [sleeve or] frame. Do not lift damper using blades or jackshaft.
  5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

### 3.4 FIELD TESTS AND ACCEPTANCE

- A. The Contractor shall provide the services of both a control system technician and a fully qualified building automation control technician who, in the presence of a representative of the Owner and A/E will perform the tests. Tests will be witnessed after the Contractor is satisfied that the system has been adjusted and is operating in accordance with the Specification requirements.
- B. Test Procedure
1. Temperature, Pressure, and Humidity Indication: Field measure values with test instruments; local instrument (if any) and remote display at console.
  2. Analog Limit Alarms: At the console, raise the low limit to a point above the actual measured reading in the field. Alarm should report in and be logged in on the printer. For high limit, lower the setpoint.
  3. Setpoint Reset: In field, measure condition of controlled medium with test instrument. Read corresponding value at console and read branch signal output with test instrument. Branch signal should be in same proportion of its full range as the measured medium reading is to the throttling range of the controller. Resetting the control point at the console should result in a proportionate change in branch signal.
  4. Contact Indication and Alarms
    - a. For subsystems, simulate actual function or operation in field. Jump contacts where simulation is not practical.
    - b. High or Low Limit Temperature Sensors: Simulate required limit temperature by immersing sensor in liquid of proper temperature (or other practical means). Alarm should report in at console. Repeat tests with high limit setting reduced and low limit setting increased by 5 degrees F; alarm should not report in at console.
    - c. Pressure Differential at Filters: Impress artificial pressure on high-pressure connection to simulate design differential pressure limit condition. When limiting differential pressure is reached, alarm should report in at console.

- d. Mode Change: Change mode setting at console and observe change of controlled element in field.
- e. Proving Devices: Operate related systems to activate devices and compare specified resultant function or operation.

### 3.5 MAINTENANCE SERVICE

- A. The Contractor shall perform complete maintenance of the Temperature Control Contractor for a period of one calendar year, at no additional cost to the Owner, commencing with the date when the system is accepted so that the said controls may be operated 24 hours a day, 7 days a week.
- B. The maintenance service for one year shall include all the existing actuators and control valves, compressors, air dryers and pressure regulators which are to remain and which have been either maintained and repaired or replaced as required.
- C. The Contractor shall be on-site within four (4) business hours of the service request, and shall repair, replace and re-program as soon as possible, any part or parts of the controls and system, which become unsuitable for continued use. The service performed by the Contractor shall include but not be limited to the following:
  - 1. Every 90 days within the 1-year warranty period, systematically examine, adjust, calibrate and clean all sensor, temperature controls, pressure controls, valves, relays, motors and accessories.
    - a. Systematically, furnish lubricants and lubricate such components as valve packing glands, damper bearings, linkages and switches pertaining to the control package.
    - b. Replace valve-packing materials of control valves as often as may be necessary in order to maintain the valves without leakage.
    - c. Update all software and correct all “bugs”. Modify presentation graphics based on Owner's operating experience.
- D. The Contractor shall submit to the Owner a detailed record of all maintenance and servicing performed under this Contract and shall notify the Owner if during the performance of services, additional repairs or replacements have to be scheduled.

### 3.6 OPERATOR TRAINING

- A. The Contractor shall conduct formal operator training on site and shall include the following with a minimum dedicated instructor time of 4 hours. Within the warranty period, as requested by the facilities manager, one (1) additional site visits shall be included with a minimum of 4 hours on site to provide additional training.
  - 1. Basic data display and interpretation of graphics, addresses, and alarm and status descriptors. The operators shall be trained to interpret all alarm displays and printouts, request all data displays, and acknowledge and reset alarms.
  - 2. Intermediate command and program change operations. This level of operators shall be trained to execute all manual commands (start/stop, control point adjustment), and request all logs, change analog alarm limits, and change time based on/off program times and load assignments.
  - 3. Total system programming. This level of operators shall be trained to install all other programs and program changes specified herein to be keyboard programmable. This training program shall allow for a complete understanding of all application packages, custom data files and user programs, and the ability to write and change new and existing specified programs. Emphasis shall be placed on maintenance management system allowing the user to be thoroughly familiar with all aspects of the maintenance and inventory control programs. Additionally, Level 3 personnel shall be given sufficient

instruction to allow: (1) in-house diagnostics and troubleshooting of the operating system and all peripherals and to perform routine preventive maintenance; (2) ability to change DCP circuit boards and associated hardware; (3) ability to install all DCP equipment; and (4) installation of all monitor and control points.

#### PART 4 - SEQUENCE OF OPERATION

##### 4.1 Exhaust Fans:

- A. The existing exhaust fans shall remain manually operated.

##### 4.2 Rooftop Units:

1. The following operational points shall be integrated into the TCS and graphics provided to display the following operational statuses:
  - a. Supply air fan operation status.
  - b. Outdoor air temperature (if not already existing in TCS)
  - c. Mixed air temperature.
  - d. Supply air temperature.
    - a. All available control points shall be integrated via the Bacnet interface board. Coordinate with the factory controller operation and integration guide.

##### 4.3 AHU-1 and CU-1:

- a. CU-1 shall provide DX cooling to the AHU-1 system.
- b. CU-1 shall be interconnected to the TCS, and shall receive enable / disable, and status (coordinate w/ Liebert factory controller).
- c. Compressor control sequences shall be controlled by a pre-programmed factory controller.
- d. When the DAT rises 1.0 F (adj.) above the DAT setpoint of 55F, the unit shall enter cooling mode. AHU-1 shall enter limited economizing mode when the OAT is below the DAT setpoint.
- e. Cooling Mode: When in cooling mode, the compressor shall energize and operate per the factory controller sequence.

##### 1.8 Existing Variable Air Volume Boxes (no reheat, with bypass to return plenum):

- A. General:
  1. Reuse existing airflow setpoints and calibration.
  2. The typical room or zone setpoints shall be:
    - a. Heating: 70 F (adj.).
    - b. Cooling: 74 F (adj.)
  3. A limited adjustment of +/- 3.0 deg. F shall be provided on all adjustable space wall controllers.

- B. Cooling Mode: In cooling mode the VAV boxes shall be set to a minimum ventilation position during occupied periods, and shall modulate between the maximum balanced position and the minimum position as needed to maintain a space cooling setpoint of 74 deg. F (adj.).
- C. Heating Mode: In heating mode the VAV boxes shall be set to a minimum ventilation position during occupied periods, and shall modulate between the maximum balanced position and the minimum position as needed to maintain a space heating setpoint of 70 deg. F (adj.).

#### SYSTEMS POINTS

All primary area and equipment controllers shall have points available for 110 percent of total points required by the sequence of operations and general requirements listed above.

END OF SECTION

## SECTION 23 31 00

### HVAC DUCTS AND CASINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Duct materials.
2. Casings.
3. Ductwork fabrication.

###### B. Related Requirements:

1. Section 23 33 00 - Air Duct Accessories: Requirements for duct accessories as specified in this Section.

##### 1.2 REFERENCE STANDARDS

###### A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Handbook - Fundamentals.

###### B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.1M - Structural Welding Code - Steel.
3. AWS D1.2 - Structural Welding Code - Aluminum.
4. AWS D1.2M - Structural Welding Code - Aluminum.
5. AWS D9.1 - Sheet Metal Welding Code.
6. AWS D9.1M - Sheet Metal Welding Code.

###### C. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A36M - Standard Specification for Carbon Structural Steel.
3. ASTM A90 - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
4. ASTM A90M - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
5. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
6. ASTM A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
7. ASTM A568 - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

8. ASTM A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
9. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
10. ASTM A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
11. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
12. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
13. ASTM A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
14. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
15. ASTM A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
16. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
17. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
18. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
19. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).
20. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
21. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
22. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. International Code Council:

1. International Energy Conservation Code (IECC).
2. International Mechanical Code (IMC).
3. 2015 Michigan Mechanical Code (MMC).

E. NFPA:

1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

F. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA 016 - HVAC Air Duct Leakage Test Manual.
2. SMACNA 1767 - Kitchen Ventilation Systems and Food Service Equipment Guidelines.
3. SMACNA 1884 - Fibrous Glass Duct Construction Standards.
4. SMACNA 1966 - HVAC Duct Construction Standards - Metal and Flexible.

G. UL:

1. UL 181 - Factory-Made Air Ducts and Air Connectors.
2. UL 181A - Closure Systems for Use With Rigid Air Ducts.
3. UL 1978 - Grease Ducts.

### 1.3 PREINSTALLATION MEETINGS

- A. See General Requirements - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum two weeks prior to commencing Work of this Section.

### 1.4 SUBMITTALS

- A. See General Requirements - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for duct materials and manufactured spiral duct.

### 1.5 CLOSEOUT SUBMITTALS

- A. See General Requirements - Execution and Closeout Requirements: Requirements for submittals.

### 1.6 QUALITY ASSURANCE

- A. Perform Work according to SMACNA 1884 and 1966.

### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum ten years' documented experience.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.



D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Minimum Conditions: Do not install duct sealant when temperatures are less than those recommended by sealant manufacturer.
- C. Subsequent Conditions: Maintain temperatures during and after installation of duct sealant.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
  1. Verify field measurements prior to fabrication.
  2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. See General Requirements - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish two-year manufacturer's warranty for ducts.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS

- A. Performance and Design Criteria:
  1. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission of Engineer.
  2. Size round ducts installed in place of rectangular ducts according to ASHRAE Handbook - Fundamentals.
- B. Materials:
- C. Galvanized-Steel Ducts
  1. Material: ASTM A653 hot-dipped galvanized-steel sheet, FS Type B.
  2. Quality: Lock forming.
  3. Finish: G90 zinc coating according to ASTM A90.
  4. Hanger Rod:

- a. Material: Aluminum.
- b. Comply with ASTM A36.
- c. Type: Threaded

## 2.2 CASINGS

- A. Fabricate casings according to SMACNA 1966 and construct for indicated operating pressures.
- B. Doors:
  1. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles.
  2. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection.

## 2.3 FABRICATION

- A. Rectangular Ducts:
  1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible Duct. Current edition.
    - a. Provide duct material, gages, reinforcing, welding, and sealing for indicated operating pressures.
    - b. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation. For stainless steel welded duct mitered transitions may be used in lieu of radius elbows or turning vanes.
    - c. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
    - d. Rectangular duct pressure class = 4" w.g.
    - e. Stiffeners and reinforcement shall be per SMACNA duct construction standards, typically when duct dimension exceeds 36", and 4'-0" in length.
- B. Sealing:
  1. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.
  2. Sealants, Mastics, and Tapes: Comply with UL 181A and provide products bearing appropriate UL 181A markings.

## 2.4 ACCESSORIES

- A. Hangers and Supports:
  1. Provide supports for all exterior ductwork equal to MIRO 8-DS per exterior ductwork detail.

2. Hanger rods, bolts, and strut for galvanized duct in Noncorrosive Environments: Cadmium-plated steel rods and nuts.
3. Hanger rods, bolts, and strut for stainless steel welded duct shall be 304 stainless steel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. See General Requirements- Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify sizes of equipment connections before fabricating transitions.

### 3.2 PREPARATION

- A. See General Requirements - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.
- C. Install temporary closures of metal or taped polyethylene plastic on open ductwork to prevent construction dust from entering ductwork system.

### 3.3 INSTALLATION

- A. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- E. Install and seal ducts according to SMACNA 1966.
- F. Hanger and Supports:
  1. Fabricate and support ducts according to SMACNA 1884 and 1966.
  2. Threaded Rods: Provide double nuts and lock washers.
  3. Building Attachments:
    - a. Provide concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

- b. If possible, install concrete inserts before placing concrete.
- c. Powder-Actuated Concrete Fasteners:
  - 1) Use only for slabs more than 4 inches thick.
  - 2) Install after concrete is placed and completely cured.
  - 3) Do not use powder-actuated concrete fasteners for seismic restraints.
- 4. Hanger Spacing:
  - a. Comply with SMACNA 1884 and 1966.
  - b. Install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
  - c. Extend strap supports down both sides of ducts and turn under bottom at least 1 inch.
  - d. Secure hanger to sides and bottom of ducts with sheet metal screws.
- 5. Hangers Exposed to View: Provide threaded rod and angle or channel supports.
- 6. Vertical Ducts:
  - a. Support with steel angles or channel secured to sides of duct with welds, bolts, sheet metal screws, or blind rivets.
  - b. Support at each floor and at maximum intervals of 16 feet.
- 7. Upper Attachments:
  - a. Attach to structures.
  - b. Selection and Sizing: Provide pull-out, tension, and shear capacities as required for supported loads and building materials.

### 3.4 CLEANING

- A. See General Requirements - Execution and Closeout Requirements: Requirements for cleaning.
- B. Protect sensitive equipment with temporary filters or bypass during cleaning.
- C. Clean exterior of ductwork free of grease, grime, flux, stickers, markers, etc.

END OF SECTION

SECTION 23 33 00  
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Turning vanes.
- B. Related Sections:
  - 1. Section 23 31 00 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.

1.3 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Work:
  - 1. Basis of Measurement: Included in other pay items for this project.
  - 2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

1.4 REFERENCES

- A. Air Movement and Control Association International, Inc.:
  - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. ASTM International:
  - 1. ASTM E1 - Standard Specification for ASTM Thermometers.
- C. National Fire Protection Association:
  - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
  - 2. NFPA 92A - Recommended Practice for Smoke-Control Systems.
- D. Sheet Metal and Air Conditioning Contractors:
  - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- E. Underwriters Laboratories Inc.:

1. UL 555 - Standard for Safety for Fire Dampers.
2. UL 555C - Standard for Safety for Ceiling Dampers.
3. UL 555S - Standard for Safety for Smoke Dampers.

#### 1.5 SUBMITTALS

- A. See General Requirements - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for the following:
  1. Volume control dampers.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.6 CLOSEOUT SUBMITTALS

- A. See General Requirements - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

#### 1.7 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- C. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- D. NFPA 91, "Standard for the Installation of Blower and Exhaust Systems."

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

#### 1.9 PRE-INSTALLATION MEETINGS

- A. See General Requirements - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. See General Requirements - Product Requirements: Product storage and handling requirements.
- B. Protect dampers from damage to operating linkages and blades.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

- D. Storage: Store materials in a dry area indoor, protected from damage.
- E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

#### 1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.12 COORDINATION

- A. See General Requirements - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work where appropriate with building control Work.

#### 1.13 WARRANTY

- A. See General Requirements - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one-year manufacturer warranty for duct accessories.

### PART 2 - PRODUCTS

#### 2.1 TURNING VANES

- A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.
- B. Fabricate of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center, and set into side strips suitable for mounting in ducts.
- C. Construct turning vanes of the same material as the ducts in which they are installed. Construct turning vanes for low and medium pressure systems of 20 gauge galvanized steel or the equivalent thickness for other duct materials as shown in the specification.
- D. Turning vanes shall be double vanes as manufactured by Ductmate or approved equal or shop fabricated turning vanes constructed to the same standards. Submit samples of shop fabricated units for approval.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. See General Requirements - Administrative Requirements: Coordination and project conditions.

- B. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.
- C. Verify ducts and equipment installation are ready for accessories.
- D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

### 3.2 INSTALLATION.

- A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards. Provide volume damper at every take off from any duct.
- B. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- C. Install turning vanes in square or rectangular 90 deg. elbows in supply and exhaust air systems, and elsewhere as indicated
- D. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

END OF SECTION



## SECTION 23 74 00

### PACKAGED OUTDOOR HVAC EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Packaged gas-electric high efficiency single zone variable air volume roof top unit(s).
2. Stand-alone digital controls and thermostat.
3. Roof top unit accessories.
4. Roof curb.

###### B. Related Requirements:

1. Section 23 31 00 – HVAC Ducts and Casings
2. Section 26 03 03 – Equipment Wiring Connections

##### 1.2 REFERENCE STANDARDS

###### A. National Fire Protection Association

1. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.
2. NFPA 54 National Fuel Gas Code.

###### B. American National Standards Institute

1. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
2. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.
3. ANSI/ASHRAE/IES 90 A - Energy Conservation in New Building Design Standard.
4. ANSI/UL 465 - Central Cooling Air Conditioners Standard for safety requirements.
5. ANSI/NFPA 70-1990 - National Electric Code.
6. ANSI Z21.47 - Gas-Fired Central Furnaces

###### C. Air Conditioning and Refrigeration Institute

1. ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
2. ARI Standards 210 and 270.
3. ARI 210/240 - Unitary Air-Conditioning Equipment and Air- Source Heat Pump Equipment. (all under 135,000 btus)
4. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

- D. American Society of Heating, Refrigerating, and Air-Conditioning
  - 1. ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
- E. Equipment shall be UL tested and certified with ANSI Z 21.47 and CSA or CGA certified as a package.

### 1.3 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Packaged Outdoor HVAC Equipment
  - 1. Basis of Measurement: Included in other pay items for this project.
  - 2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

### 1.4 SUBMITTALS

- A. See General Requirements for Submittal Procedures specifies requirements for submittals.
- B. Product Data:
  - 1. Provide data cut sheets on all equipment.
- C. Submit shop drawings for all equipment in accordance with general requirements.
  - 1. Operation and Maintenance Data.
  - 2. Include manufacturer's descriptive literature, start-up and operating instructions, installation instructions, and maintenance procedures

### 1.5 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation.

### 1.6 WARRANTY

- A. Provide a full parts and labor warranty for two years from start-up or 27 months from shipping date.
- B. Mechanical Contractor shall include two year labor warranty.

## PART 2 - PRODUCTS

### 2.1 SUMMARY

- A. The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

- B. MANUFACTURERS
  - 1. Trane Corporation
  - 2. Aeon
  - 3. Or Approved Equal

## 2.2 UNIT DESCRIPTION

### A. General:

1. See Roof Top Unit Schedule, and match type, efficiency, capacity, airflow, and accessories as scheduled.
2. Packaged high-efficiency rooftop unit shall include compressors, evaporator coils, filters, direct-drive supply fan, ASHRAE 90.1-2013 dampers, air-cooled condenser coils, ASHRAE 90.1-2013 variable speed condenser fans, modulating gas heaters, MERV 8 filters, and stand-alone digital controls with programmable thermostat and Bacnet interface board (for future use).
3. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
4. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
5. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
6. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
7. Installation, Operation, and Maintenance manual shall be supplied within the unit.
8. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
9. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
10. Native Bacnet, IP equipment controller for interconnection, interoperability, and integration into a future Bacnet-based building control system.
11. Discharge: Downflow.

### B. Construction:

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access

doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. Access to filters, dampers, cooling coils, heaters, dampers, controllers, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
8. Galvanized or HDPE drain pans.
9. Unit shall include lifting lugs on the top of the unit.

C. Heating Section:

1. Tubular heat exchanger design using corrosion resistant steel throughout.
2. Induced draft combustion blower.
3. Direct spark ignition (DSI) system. On initial call for heat, the combustion blower will purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system will be locked out until manually reset at the thermostat/zone sensor.

D. Compressors:

1. Variable speed scroll compressor shall be capable of speed modulation from 15Hz to a maximum of 60 Hz. The minimum unit capacity shall be 25% of full load or less. The compressor motor shall be a permanent magnet type. Each variable speed compressor shall be matched with a specially designed, refrigerant-cooled, variable frequency drive which modulates the speed of the compressor motor and provides several compressor protection functions. Control of the variable speed compressor and inverter control, as well as tandem direct-drive, scroll type compressors, shall be integrated with the unit controller to ensure optimal equipment reliability and efficiency. Each compressor shall have a crankcase heater installed, properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

E. Evaporator and Condenser Coils:

1. Internally finned, 5/16" copper tubes are mechanically bonded to a configured aluminum plate fin. The microchannel type condenser coil uses flat streamlined tubes with small ports, and metallurgical tube-to-fin bond.
2. Evaporator coil and condenser coil shall be leak tested to 600 psig. The assembled unit shall be leak tested to 465 psig. The plate fin condenser coil shall have a hybrid coil designed with slight gaps for ease of cleaning. A plastic, dual-sloped, removable and reversible condensate drain pan with through-the-base condensate drain is standard.

F. Supply Fan:

1. Unit shall include direct drive, unhooded, backward curved, direct drive or belt driven fan as scheduled.
2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

4. Variable frequency drives (where required per ASHRAE 90.1-2013 shall be factory wired and mounted in the unit and shall include a 5% line reactor. Fan motors shall be premium efficiency.

G. Condenser Fan:

1. Direct-drive, variable speed, ASHRAE 90.1-2013, statically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.

H. Electrical:

1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
2. Unit shall be provided with a factory installed and factory wired 115V, 12 amp GFI outlet disconnect switch in the unit control panel.

I. Accessories:

1. Modulating natural gas burner.
2. ASHRAE 90.1-2013 Low leakage outdoor air damper.
3. ASHRAE 90.1-2013 100% full economizer with dry-bulb controls (set to 70 deg. F.)
4. Barometric relief air damper.
5. Demand Control CO2 Ventilation (DCV) controller. Set minimum position to 100% closed position (since space is rarely occupied.)
6. Hinged access doors.
7. 18" solid bottom, insulated, roof curb.
8. Programmable T-stat with LCD display.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Contractor shall install in strict accordance with manufacturer's instructions.
- B. Install units plumb and level.
- C. Unit footprint including intake hood must be a minimum of 10'-0" horizontally from roof edge.
- D. Install per NFPA 90A and NFPA 54.
- E. Mount unit on factory built 24" insulated roof curb. Coordinate roof type with General Contractor or Construction Manager, and Roofing Contractor.
- F. Install accessories furnished by manufacturer but not specified to be factory installed.
- G. Verify electrical wiring is installed in accordance with the manufacturer's approved submittal.
- H. Control wiring shall be included as part of the work of this section. Field wiring of zone controls to be NEC, Class I and Class II per space requirements. Coordinate with Electrical Contractor. All wiring exterior to unit shall be completed by Electrical Contractor.

- I. Factory authorized start-up: Mechanical Contractor shall work with a factory trained and authorized service technician to check, test, and commission the unit. Factory authorized personnel shall provide a copy of start-up report to Engineer for review and approval, and then include approved reports in O&M Manual.
- J. Provide two hours instruction to owner's personnel in operation and maintenance of units.
- K. Install exterior-grade plastic, UV resistant, laminate identification nameplate(s) with corrosion resistant fasteners on all units.
- L. Test and Balance - Unitary testing only which includes supply airflow, fresh air airflow and unit profile. Distribution ductwork or variable airflow boxes are not part of the scope at this time. See Test and Balance specification for more information.

END OF SECTION

## SECTION 23 81 26

### SPLIT-SYSTEM AIR-CONDITIONING UNITS

#### PART 1 - GENERAL-

- A. This Section includes single and multi-zone ductless split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.2 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. Operation and Maintenance Data: For split-system air-conditioning units to include in operation and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

#### 1.3 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL 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" and/or Federal DOE standards.
- 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" and/or Federal DOE standards.

## 1.4 COORDINATION

- A. Coordinate location and methods of installation for indoor evaporators and outdoor heat-pump/condensing units. Provide condensing unit pad for ground or roof installation, or concrete housekeeping pad for ground installation.
- B. Coordinate roof penetrations and Pate Curbs, or Pate Boots, or wall penetrations where needed for refrigerant line- sets and electrical wiring.
- C. Coordinate thermostat and electrical box location with electrical contractor.
- D. Coordinate sanitary condensate piping with plumbing contractor. If a condensate pump is needed, coordinate mounting with general trades, and wiring and receptacle placement with electrical contractor.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years for compressor and refrigerant circuit, and one year from date of substantial completion for other components.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Split-System Ductless Air-Conditioning Units:
    - a. Liebert
    - b. Equals as approved by Engineer before bidding, otherwise:
    - c. Others by voluntary alternate only.



## 2.2 MANUFACTURED UNITS

### A. Ductless Split System Air Conditioner (Single or Multi Zone):

1. Complete packaged air conditioning unit factory fabricated and tested.
2. Indoor evaporator sections: Complete with fan section, motor, washable filter, condensate drain pan designed for gravity drain sanitary piping or field installed condensate pump, and direct expansion evaporator section. Compressor may be located within indoor or outdoor unit.
3. Air cooled condensing section: Completely factory piped for single point connection of refrigerant lines serving one, two, three or four remote evaporator sections. Condensing unit with propeller fan shall be matched to combined evaporator sections to provide cooling capacities as scheduled on drawings. Compressor may be located within indoor or outdoor unit.
4. Controls: Unit furnished with factory installed microprocessor controls. Provide hard-wired wall thermostat under tamper-proof thermostat box for each evaporator section which shall provide selection of all functions and control of room temperature set points. Furnish and install one mounting bracket for each remote control.
5. Include Bacnet interface board controller with each unit.
6. Provide complete refrigerant piping circuits (including all piping specialties) sized in accordance with manufacturer's requirements to interconnect evaporator and condenser sections.

## 2.3 CEILING-MOUNTING, EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel chassis with removable panels on front and ends, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, with thermal-expansion device.
- C. Fan: Direct drive, ultra-quiet centrifugal fan, and integral factory or field installed condensate pump.
- D. Fan Motors: Comply with requirements.
  1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

E. Filters: Permanent, cleanable.

## 2.4 AIR-COOLED, CONDENSER-COMPRESSOR COMPONENTS

- A. Casing: Steel, finished with baked enamel, 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: Variable-speed, inverter drive digital scroll, with low ambient cooling capable of providing 100% capacity down to -20F.
- C. Not applicable to this project: Heat Pump Components: Reversing valve and low-temperature. Heat pump thermostat with adjustable, programmable, heat pump cut-out temperature adjustment.
- D. Fan: Aluminum-propeller type directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.

## 2.5 ACCESSORIES

- A. Thermostat: Hard-wired, wall-mounted low voltage type to control compressor and evaporator fan. Include tamper-proof thermostat cover.
  - 1. Liquid-crystal display indicating temperature, set-point temperature, operating mode, and fan speed.
  - 2. Fan-speed selection.
  - 3. Not applicable to this project: Heat Pump Cut-Out Temperature
  - 4. 7-day scheduling programmability.
  - 5. Bacnet interface board (integration to the TCS).
- B. Automatic-reset timer to prevent rapid/short cycling of compressor.
- C. Low-ambient cooling kit.
- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, and sealed; factory-insulated suction line.

## 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 condensing unit pad with wind bracing anchors and support.
- D. Install and connect refrigerant tubing to components. Install tubing to allow access to unit. Evacuate and charge with refrigerant in strict accordance with manufacturers instructions.

### 3.2 CONNECTIONS

- A. Install piping adjacent to unit to allow service and maintenance.
- B. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in accordance with manufacturers' instructions.

### 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.

END OF SECTION

## SECTION 26 00 00

### ELECTRICAL GENERAL PROVISIONS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. The general provisions of the contract including General and Supplementary Conditions and General Requirements shall apply to all work under this Specification Division.

##### 1.02 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

- A. Equipment, fixtures, material, and installation shall conform to the requirements of the local Building Department, the serving utility companies, the local and National Electrical Codes (NEC), National Electrical Safety Code, Life Safety Code, Occupational Safety and Health Act, and applicable national, state, and local codes, ordinances, and regulations.
- B. All equipment shall be equal to or exceed the minimum requirements of NEMA, IEEE, and UL.
- C. Should any change in Drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify Architect/Engineer prior to execution of the Work. The work shall be carried out according to the requirements of this code in accordance with the instruction of the Architect/Engineer and at no additional cost to the Owner.
- D. The provisions of Standards, Codes, Laws, Ordinances, etc., shall be considered minimum requirements. In case of conflict between their published requirements, the Owner's Representative shall determine which is to be followed and their decision shall be binding. Specific requirements of this specification or the drawings, which exceed the published requirements, shall take precedence over them.

##### 1.03 FEES

- A. All local fees, permits, and services of inspection authorities shall be obtained and paid for by the Contractor. The Contractor shall cooperate fully with local companies with respect to their services. The Owner shall pay for all incurred costs relative to the utility power service (primary and/or secondary) and the utility communication services (including, but not limited to, telephone, television, internet, etc.).

##### 1.04 SCOPE OF WORK

- A. This division of the specifications covers the electrical systems of the project. It includes work performed by the electrical trades as well as trades not normally considered as electrical trades.

- B. Provide all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor consumable items, fees, licenses, etc., necessary to provide complete systema. Perform start-up and checkout on each item and system to provide complete and fully operable systems.
- C. Examine and compare the Electrical Drawings with these specifications. Report any discrepancies between them to the Architect/Engineer and obtain written instructions from them for changes necessary in the work. At the time of the bid the most stringent requirements must be included in the bid.
- D. Examine and compare the Electrical Drawings and Specifications with the Drawings and Specifications of other trades. Report any discrepancies between them to the Architect/Engineer and obtain written instructions from them for changes necessary in the work. At time of bid, the most stringent requirements must be included in said bid.
- E. Install and coordinate the electrical work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the Contractor, caused by their neglect to do so, shall be made by them at their own expense.
- F. It is the intent of the Drawings and Specifications to provide a complete workable system ready for the Owner's operation. Any item not specifically shown on the Drawings or called for in the Specifications, but normally required to conform with the intent, are to be considered a part of the Contract.
- G. All materials furnished by the Contractor shall be new and unused (temporary lighting and power products are excluded) and free from defects. All material used shall bear the Underwriter's Laboratory, Inc. label, or an approved equivalent third-party testing agency, provided a standard has been established for the material in question.
- H. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or materials shall be the product of one manufacturer throughout the entire project. Multiple manufacturers will not be permitted.

#### 1.05 REFERENCES

- A. Utilize the following abbreviations and definitions for discernment within the Drawings and Specifications.
  - 1. Abbreviations
    - a. NEC National Electrical Code.
    - b. OSHA Occupational Safety and Health Act.
    - c. ANSI American National Standards Institute.
    - d. NFPA National Fire Protection Association.
    - e. ASA American Standards Association.
    - f. IEEE Institute of Electrical and Electronics Engineers.
    - g. NEMA National Electrical Manufacturers Association.
    - h. UL Underwriters' Laboratories, Inc.
    - i. IBC International Building Code.
    - j. IES Illuminating Engineering Society.
    - k. ICEA Insulated Cable Engineers Association.
    - l. ASTM American Society of Testing Materials.

- m. ETL Electrical Testing Laboratories, Inc.
- n. CBM Certified Ballast Manufacturers.
- o. EIA Electronic Industries Association.
- p. LED Light Emitting Diode.
- q. OEM Original Equipment Manufacturer.

## 1.06 DEFINITIONS

- A. Provide: means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, deplete and ready for regular operations, the particular Work referred to.
- B. Install: means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
- C. Furnish: means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
- D. Wiring: means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connections with such Work.
- E. Conduit: means the inclusion of all fittings, hangers, supports, sleeves, etc.
- F. As Directed: means as directed by the Architect/Engineer, or their representative.
- G. Concealed: means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above accessible suspended ceilings.

## 1.07 COORDINATION OF THE WORK

- A. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.
- B. Carefully check space requirements with other trades and the physical confines of the area to ensure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications here to as required and approved.
- C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
- D. Wherever work interconnects with the work of other trades, coordinate with other trades to ensure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
- E. Coordinate, forecast, and schedule work with other trades in accordance with the construction sequence.

- F. The Drawings show only the general run of raceways and approximate location of outlets. Any significant changes in the location of outlets, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive their approval before such alterations are made. All such minor modifications shall be made without additional cost to the Owner.
- G. Obtain from the Architect/Engineer in the field the location of such outlets or equipment not located on the Drawings.
- H. Circuit “tags” are used where shown to indicate the designated branch circuits. These tags show the branch circuits and the panel designation. Show the actual circuits numbers used on the finished record drawings and on panel directory card. Where circuiting is not indicated, Electrical Subcontractor must provide required circuiting in accordance with the loading indicated on the drawings and/or as directed.
- I. Adjust location of conduits, panels, equipment, pull boxes, fixtures, etc. to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each raceway prior to fabrication.
  - 1. Right-of-Way:
    - a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
    - b. Make offsets, transitions, and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines, whether or not, indicated on the Drawings.
- J. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale like that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work is to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.
- K. Coordinate with the local Electric Utility Company and the local Communications Companies (as directed by the Owner) as to their requirements for service connections and provide all necessary materials, labor, and testing.
- L. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor’s work.

#### 1.08 EXAMINATION OF SITE

- A. Prior to the submitting of bids, the Contractor shall visit the site of the job and shall familiarize themselves with all conditions affecting the proposed installation and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph will in no way relieve the contractor of performing all necessary work shown on the Drawings.

## 1.09 PROGRESS OF THE WORK

- A. The Contractor shall order the progress of their work to conform to the progress of the work of other trades and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from the defective or ill-timed work performed under this section shall be borne by the Contractor.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Ship and store all products and materials in a manner that will protect them from damage, weather, and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair. Any such repairs shall be subject to review and acceptance of the Architect/Engineer.
- B. Deliver materials in manufacturer's unopened container fully identified with manufacturer's name, trade name, type, class, grade, size, and color.
- C. Store materials suitably sheltered from the elements, but readily accessible for inspection by the Architect/Engineer until installed. Store all items subject to moisture damage in dry, heated spaces.

## 1.11 EQUIPMENT ACCESSORIES

- A. Provide supports, hangers, and auxiliary structural members required for support of the work.
- B. Furnish and set all sleeves for passage of raceways through structural, masonry and concrete walls of floors and elsewhere as will be required for the proper protection of each raceway passing through building surfaces.

## 1.12 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Provide operations and maintenance (O&M) manuals in accordance with the Contract Documents.
  - 1. Provide two (2) copies of each manual, as well as an electronic copy in PDF format.
  - 2. Manuals shall be 8-1/2 inches x 11 inches in hard cover 3-ring loose leaf binders.
  - 3. Manuals shall be complete and in Owner's hands prior to turning building over to Owner and at least 10 days prior to instruction to operating personnel.
- B. Provide O&M manuals including but not limited to the following:
  - 1. Alphabetical list of all system components, with the name, address, and phone number of the company responsible for servicing each item during the first year of operation.
  - 2. Operating instructions for complete system including:
    - a. Normal starting, operating and shutdown.
    - b. Emergency procedures for fire or failure of major equipment.
    - c. Summer and winter special procedures, if any.
    - d. Day and night special procedures, if any.
  - 3. Maintenance instruction including:
    - a. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated.
    - b. Necessary cleaning, replacement and/or adjustment schedule.



4. Manufacturer's data for each piece of equipment including:
  - a. Installation instructions.
  - b. Drawings and specifications.
  - c. Parts list, including recommended items to be stocked.
  - d. Complete wiring diagrams.
  - e. Marked or changed prints locating all concealed parts and all variations from the original system design.
  - f. Test and inspection certificates.
- C. Refer to individual specification sections for additional O&M requirements.

### 1.13 RECORD DOCUMENTS

- A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is installed. Keep this record set of prints at the job site for review by the Architect/Engineer and the Code Officials.
- B. Upon completion of the installation and acceptance by the Owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
- C. Provide in each main electrical room at the Main Distribution Panel #MDP location a framed copy under glass -or a laminated copy of the appropriate Single Line Riser Diagram as reviewed by the electrical engineer. Media shall be a high-quality presentation type paper. Blueprints or other media which fade shall not be used.

### 1.14 GUARANTEE

- A. Guarantee all material and workmanship for a period of one (1) year from date of final acceptance by the Owner, except where guarantees or warranties for longer terms are specified herein, such longer term to apply. Within 24 hours after notification, correct any deficiencies that occur during the guarantee period at no additional cost to the Owner, all to the satisfaction of the Owner and Architect/Engineer. Obtain similar guarantees from subcontractors, manufacturers, suppliers and subtrade specialists.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Applicable equipment and materials shall be listed by Underwriters' Laboratories and manufactured in accordance with ASME, NEMA, ANSI or IEEE standards, and as approved by local authorities having jurisdiction.
- B. If products and materials are specified or indicated on the Drawings for a specific item or system, use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, subject to approval of Shop Drawings where Shop Drawings are required or as approved in writing where Shop Drawings are not required.

- C. All equipment capacities, etc. are listed for job site operating conditions. All equipment sensitive to altitudes or ambient temperatures to be derated and method of derating shown on Shop Drawings. Where operating conditions shown differ from the laboratory test conditions, the equipment shall be derated and the method of derating shown in Shop Drawings.

## 2.02 SUBSTITUTION OF MATERIALS OR EQUIPMENT

- A. All requests for substitution of materials or equipment shall be made in writing by the Contractor. The request must be in the Architect/Engineers' office not less than 10 days prior to the bid date. Samples of proposed substitute materials or equipment shall be submitted to the Architect/Engineer for review whenever they are requested. Bids shall be based only upon the specified materials and equipment or substitutes that have received written acceptance from the Architect/Engineer prior to the bid.
- B. Wherever the words "for approval" or "approved" are used regarding manufactured specialties, or wherever it is desired to substitute a different make or type of apparatus for that specified, submit all information pertinent to the adequacy and adaptability of the proposed apparatus, and secure Architect/Engineer's acceptance before apparatus is ordered.
- C. Wherever quantities or a definite make and size of apparatus is specified, the make and size of apparatus which is proposed must conform substantially (regarding the operating results) to that specified or implied. The same shall apply to important dimensions relating to the operation of an apparatus in coordination with the rest of the system, or to properly fitting it into available space conditions. Any substitution of equipment or apparatus shall include all necessary revisions, as required to complete the installation.
- D. Acceptance of substitutions, for equipment specified herein, will not be given merely upon submission of manufacturer's names, and will be given only after receipt of complete and satisfactory performance data covering the complete range of operating conditions. Furnish complete and satisfactory information relative to equipment dimensions, weight, etc. Any additional construction and design costs incurred as a result of any accepted substitution shall be borne by the Contractor. The opinion and judgement of the Architect/Engineer shall be final, conclusive, and binding.

## 2.03 SHOP DRAWINGS

- A. Prepare and submit detailed Shop Drawings for materials, systems, and equipment as listed herein, including locations and sizes of all required openings in floor decks, walls, and floors. Submit under provisions of Section 01 33 00.
- B. The Work described in any Shop Drawing submission shall be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions, and proper coordination with all trades on the job. Each Shop Drawing submitted shall include a verification that all related job conditions have been checked and that no conflict exists.
- C. All drawings shall be submitted sufficiently in advance of field requirements to allow ample time for checking and resubmittal as may be required. All submittals shall be complete and contain all required information.

- D. Acceptance of any submitted data or Shop Drawings for material, equipment apparatus, devices, arrangements, and layout shall not relieve Contractor from responsibility of furnishing same of proper dimensions and weight, capacities, sizes, quantity, quality, and installation details, to efficiently perform the requirements and intent of the Contract. Such acceptance shall not relieve the Contractor from responsibility for errors, omissions, or inadequacies of any sort on submitted data or Shop Drawings.
- E. Each Shop Drawing shall contain the following information:
  - 1. Provide general information on each copy of the submittal.
    - a. Project title.
    - b. Reference to the applicable drawing and specification article.
    - c. Contractor and supplier identification, addresses and telephone numbers.
    - d. Submittal date.
  - 2. Certification that the contractor has reviewed the submittal.
  - 3. Refer to individual specification sections for additional information requirements.
- F. Shop Drawing submittals shall be provided for each specific material, system, or equipment as identified herein.
  - 1. As a minimum, make submittals on the following items:
    - a. Raceways, conduit, and wire
    - b. Wiring devices and plates
    - c. Panelboards/Loadcenters
    - d. Fuses
    - e. Disconnect safety-switches
    - f. Generator
    - g. Automatic Transfer Switch
    - h. Extension of fire alarm notification and smoke and carbon dioxide detection systems.
  - 2. Refer to individual specification sections for additional information requirements.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Follow manufacturer's instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Architect/Engineer before installing any equipment. Provide a copy of such instructions for the equipment during any work on the equipment.
- B. Use mechanics skilled in their trade for all work.
- C. Keep all items protected before and after installation. Clean up all debris at the end of each workday. Maintain public access/entries as coordinated with the Owner during construction.
- D. Before commencing Work, examine all adjoining, underlying, etc. on which this Work is in any way dependent for perfect workmanship and report any condition which prevents performance of first-class work. Become thoroughly familiar with the actual existing conditions to which connections must be made or which must be changed or altered.

### 3.02 EXCAVATION, TRENCHING AND BACKFILL

- A. Provide excavation for the Work. Excavate all material encountered, to the depths indicated on the drawings or required. Remove from the site, excavated materials not required or suitable for backfill. Provide grading, as may be necessary, to prevent surface water from flowing into trenches or other excavations. Remove any water accumulating therein. Provide sheeting and shoring as may be necessary for the protection of the Work and for the safety of personnel.
- B. Provide trenches of widths necessary for the proper execution of the Work. Grade bottom of the trenches accurately to provide uniform bearing and support the Work on undisturbed soil at every point along its entire length. Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required, excavate rock to a minimum overdepth of four (4") inches below the trench depths indicated on the Drawings or required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose granular, moist earth, thoroughly machine tamped, to a compaction level of at least 95 percent to standard protector density or 75 percent relative density or as specific by the Architect/Engineer. Whenever unstable soil that is incapable of properly supporting the Work, as determined by Architect/Engineer, is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel, or other suitable material.
- C. Excavate trenches for utilities to a depth that will provide the following minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown.
  - 1. Primary electric service: four (4) feet (minimum)
  - 2. Secondary electric service: two (2) feet (minimum)
  - 3. Branch electrical circuits: per National Electric Code (NEC).
  - 4. Telephone service: two (2) feet (minimum)]
- D. Trenches shall not be placed within ten (10) feet of foundation or soil surfaces which must resist horizontal forces.
- E. Do not backfill trenches until all required tests have been performed and the installation observed but the Architect/Engineer or Code Official as required. Comply with the requirements of other sections of these specifications. Backfill shall consist of non-expansive soil with limited porosity. Deposit in six (6") inch layers and thoroughly and carefully tamp until the Work has a cover of not less than one (1) foot. Backfill and tamp remainder of trench at twelve (12") inch intervals until complete. Uniformly grade the finished surface. Backfill and tamp with compaction at least equal to the surrounding area.

### 3.03 CUTTING, PATCHING AND REPAIRING

- A. The work shall be carefully laid out in advance. Where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for the proper installation, support or anchorage of raceway, outlets or other equipment, the work shall be carefully done. Any damage to the building, piping, equipment or defaced finish plaster, woodwork, metalwork, etc. shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.

- B. Where conduits, mounting channels, outlet, junction, or pull boxes are mounted on a painted or stucco finished surface, or a surface to be finished, they shall be painted to match the surface. Whenever support channels are cut, the bare metal shall be cold galvanized.

### 3.04 CLEANING UP

- A. The Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of their work. The Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
- B. The Contractor shall clean up all fixtures and equipment at the completion of the project.
- C. All switchboards, panelboards, loadcenters, wireways, trench ducts, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

### 3.05 WATERPROOFING

- A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
- B. If Contractor penetrates any walls or surfaces after they have been waterproofed, they shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at their own expense.

### 3.06 SUPPORTS

- A. Support work in accordance with the best industry practice and the following.
- B. Include supporting frames or racks extending from building structure for work indicated as being supported from walls where the walls are incapable of supporting the weight. Provide such frames or racks in electric closets.
- C. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a free-standing position.
- D. Supporting frames or racks shall be of standard angle, standard channel, or specialty support system steel members. They shall be rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.
- E. Nothing, (including outlet, pull and junction boxes for fittings) shall depend on electric conduits, raceways, or cables for support, except that threaded hub type fittings having a gross volume not in excess of 100 cubic inches may be supported from heavy wall conduit, where the conduit is securely supported from the structure within five inches of the fitting on two opposite sides.

- F. Nothing shall rest on, or depend for support on, suspended ceilings media (tiles, lath, plaster, as well as splines, runners, bars, and the like in the plane of the ceiling).
- G. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure.

### 3.07 FASTENINGS

- A. Fasten electric work to building structure in accordance with the best industry practice and the following.
- B. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
- C. For items which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging, tying to the building structure elements.

### 3.08 TESTING EQUIPEMNT AND MATERIALS

- A. The Contractor shall provide all testing instruments, equipment and all materials, connections, labor, etc., required to perform tests.
- B. Test all circuits, fixtures, equipment, and systems for proper operation and freedom from grounds, shorts and open circuits before acceptance is requested.
- C. Measure voltage at panelboards/loadcenters and outlets after the building is fully occupied. Make final transformer tap adjustments (if applicable) based on these measurements.
- D. Perform all tests required by local authorities, such as tests of life safety systems, in addition to tests specified herein.
- E. Perform tests required by other specification sections.

END OF SECTION

## SECTION 26 05 01

### SELECTIVE ELECTRICAL DEMOLITION

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. Work Included: Selective electrical demolition for remodeling.
- B. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
- C. Disposal of materials.
- D. Storage of removed materials.
- E. Identification of utilities.
- F. Salvaged items.
- G. Protection of items to remain as scheduled at end of section or as indicated on Drawings.
- H. Relocate existing equipment to accommodate construction.

##### 1.2 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of capped utilities, conduits and equipment abandoned in place, and any remaining items originally scheduled for demolition.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Verify termination points for demolished services.
- D. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.
- F. CAUTION!!! Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.
- G. Field identify salvage items in cooperation with Owner.

### 3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with the Owner and the Electric Utility Company.
- C. Conduct demolition to minimize interference with adjacent building areas.
- D. Coordinate demolition work with Owner, Architect/Engineer, and all other trades.
- E. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- F. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- G. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. CAUTION!!! - See bid documents for potential Liquidated Damages regarding extended power outages to the building's electrical services.
- H. Existing Fire Alarm Notification and Smoke Detection Systems: Maintain existing system in service during construction. Disable system only to make switchovers and connections. Obtain permission from the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- I. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- J. Provide and install temporary egress signage and emergency lighting as required.

### 3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work as indicated on Drawings.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply, as coordinated with the Owner. This includes but is not limited to power conductors, fire alarm cables, low-voltage cabling and control wiring, unless noted otherwise.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces to match existing adjacent finishes.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlet boxes if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes and flush junction boxes that are not removed.
- F. Disconnect and remove abandoned panelboards/loadcenters and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.



- H. Repair adjacent construction and finishes damaged during demolition and extension work to match existing.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panels as appropriate.
- J. Extend existing installations using materials and methods as specified.

#### 3.4 EXISTING PANELBOARDS/LOADCENTERS

- A. Ring out circuits in existing panels affected by the Work. Where additional circuits are needed, reuse circuits that are available for reuse. Install new breakers as required.
- B. Tag unused circuit breakers as "Spare C.B."
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories where circuits have been modified or rewired.

#### 3.5 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or are to be reused.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Panelboards/loadcenters: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

#### 3.6 INSTALLATION

- A. Install relocated materials and equipment as indicated in other specification Sections and on the Drawings.
- B. Remove existing wire no longer in use from panel to equipment.
- C. Include new blank filler plates, as required, on all open circuit breaker spaces that will remain a prepared space at project completion.
- D. Carefully remove equipment, materials, or fixtures which are to be reused/relocated and remain.
- E. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

END OF SECTION

## SECTION 26 05 19

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes building wire and cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.
- B. Related Sections:
  - 1. Section 26 05 53 - Identification for Electrical Systems: Product requirements for wire identification.
  - 2. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
  - 3. Section 31 23 23 - Fill: Requirements for backfill to be placed by this section.

##### 1.2 REFERENCES

- A. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
  - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
  - 1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

##### 1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
  - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
  - 2. Stranded conductors for control circuits.
  - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
  - 4. Conductor not smaller than 14 AWG for control circuits.
  - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
  - 1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway, armored cable or metal clad cable.
  - 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway, armored cable or metal clad cable.

3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway, armored cable or metal clad cable.
4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway, direct burial cable, armored cable or metal clad cable.
5. Exterior Locations: Use only building wire, Type THHN/THWN insulation, in raceway, direct burial cable, service-entrance cable, armored cable or metal clad cable.
6. Underground Locations: Use only building wire, Type THHN/THWN insulation, in raceway, direct burial cable, service-entrance cable, armored cable or metal clad cable.

#### 1.4 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements, terminations, conductor ampacity and voltage drop.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit for building wire and each cable assembly type.
- C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- D. Test Reports: Indicate procedures and values obtained.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and circuits.

#### 1.7 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Perform Work in accordance with all applicable Federal, State, and local Codes and Ordinances.
- C. Maintain one copy of each document on site.

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

## 1.9 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

## 1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Where wire and cable destinations are indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 ft of length shown.

## PART 2 - PRODUCTS

### 2.1 BUILDING WIRE

- A. Manufacturers:
  - 1. Cerro Wire LLC.
  - 2. General Cable; General Cable Corporation.
  - 3. Southwire Company.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 105 degrees C.
- F. Insulation Material: Thermoplastic.

### 2.2 DIRECT BURIAL CABLE

- A. Manufacturers:
  - 1. Cerro Wire LLC.
  - 2. General Cable; General Cable Corporation.
  - 3. Southwire Company.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.

## 2.3 SERVICE ENTRANCE CABLE

- A. Manufacturers:
  - 1. Cerro Wire LLC.
  - 2. General Cable; General Cable Corporation.
  - 3. Southwire Company.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: Type USE, SE, or USE-2, as approved by Utility Company.

## 2.4 ARMORED CABLE

- A. Manufacturers:
  - 1. Cerro Wire LLC.
  - 2. General Cable; General Cable Corporation.
  - 3. Southwire Company.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Armor Material: Steel.
- G. Armor Design: Interlocked metal tape.

## 2.5 METAL CLAD (MC) CABLE

- A. Manufacturers:
  - 1. Cerro Wire LLC.
  - 2. General Cable; General Cable Corporation.
  - 3. Southwire Company.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic.

- F. Armor Material: Steel.
- G. Armor Design: Interlocked metal tape.
- H. Jacket: Where required.

## 2.6 WIRING CONNECTORS

- A. Split Bolt Connectors:
  - 1. Manufacturers:
    - a. Burndy: Part of Hubbell Electrical Systems.
    - b. ILSCO.
    - c. Thomas & Betts Corporation; A Member of the ABB Group.
    - d. Substitutions: Section 01 60 00 - Product Requirements.
- B. Solderless Pressure Connectors:
  - a. Burndy: Part of Hubbell Electrical Systems.
  - b. ILSCO.
  - c. Thomas & Betts Corporation; A Member of the ABB Group.
  - d. Substitutions: Section 01 60 00 - Product Requirements.
- C. Spring Wire Connectors:
  - 1. Manufacturers:
    - a. Burndy: Part of Hubbell Electrical Systems.
    - b. ILSCO.
    - c. Thomas & Betts Corporation; A Member of the ABB Group.
    - d. Substitutions: Section 01 60 00 - Product Requirements.
- D. Compression Connectors:
  - 1. Manufacturers:
    - a. Burndy: Part of Hubbell Electrical Systems.
    - b. ILSCO.
    - c. Thomas & Betts Corporation; A Member of the ABB Group.
    - d. Substitutions: Section 01 60 00 - Product Requirements.

## 2.7 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.

### 3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

### 3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes are abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel(s).
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

### 3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
  - 1. Pull conductors into the raceway at same time.
  - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:
  - 1. Protect exposed cable from damage.
  - 2. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
  - 3. Use suitable cable fittings and connectors.
- F. Special Techniques - Direct Burial Cable:

1. Trench and backfill for direct burial cable installation. Refer to Section 31 23 23 and Section 31 23 17. Install warning tape along the entire length of direct burial cable, within 3 inches of grade.
2. Use suitable direct burial cable fittings and connectors.

G. Special Techniques - Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
7. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only. Fill with an antioxidant compound before installing conductor.
8. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.

H. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

I. Install terminal lugs on ends of 600-volt wires unless lugs are furnished on connected device, such as circuit breakers.

J. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.

K. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

### 3.5 WIRE COLOR

A. General:

1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
  - a. Black and red for single phase circuits at 120/240 volts.
  - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
  - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices, and boxes. Colors are as follows:
  - a. Black and red for single phase circuits at 120/240 volts.
  - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
  - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.



- B. Neutral Conductors: When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
  - 1. White for single phase circuits at 120/240 volts.
  - 2. White for circuits at 120/208 volts single or three phase.
  - 3. Gray for circuits at 277/480 volts single or three phase.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
  - 1. For 6 AWG and smaller: Green.
  - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

### 3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

## SECTION 26 05 26

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Rod electrodes.
  - 2. Active electrodes.
  - 3. Wire.
  - 4. Grounding well components.
  - 5. Mechanical connectors.
  - 6. Exothermic connections.
  
- B. Related Sections:
  - 1. Section 03 20 00 - Concrete Reinforcing: Bonding or welding bars when reinforcing steel is used for electrodes.

##### 1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
  - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
  - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
  
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
  
- C. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.

##### 1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
  - 1. Metal underground water pipe.
  - 2. Metal building frame.
  - 3. Concrete-encased electrode.
  - 4. Rod electrode.
  - 5. Plate electrode.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms maximum.

## 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Manufacturer's Installation Instructions: Submit for active electrodes.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

## 1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.

## 1.7 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Perform Work in accordance with all applicable Federal, State, and local Codes and Ordinances.
- C. Maintain one copy of each document on site.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience or approved by manufacturer.

## 1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene a minimum of one week prior to commencing work of this section.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

- D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

#### 1.11 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

### PART 2 - PRODUCTS

#### 2.1 ROD ELECTRODES

- A. Manufacturers:
  - 1. ERICO International Corporation.
  - 2. Harger Lightning & Grounding.
  - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description:
  - 1. Material: Copper.
  - 2. Diameter: 3/4 inch or as indicated on drawings.
  - 3. Length: 10 feet, unless otherwise indicated.
- C. Connector: Connector for exothermic welded connection.
  - 1. U-bolt clamp only allowed upon approval by Engineer.

#### 2.2 ACTIVE ELECTRODES

- A. Manufacturers:
  - 1. ERICO International Corporation.
  - 2. Harger Lightning & Grounding.
  - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description:
  - 1. Material: Metallic-salt-filled copper-tube electrode.
  - 2. Shape: As indicated on Drawings.
  - 3. Length: As indicated on Drawings.
  - 4. Connector: Connector for exothermic welded connection.
  - 5. U-bolt clamp only allowed upon approval by Engineer.

#### 2.3 WIRE

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Copper conductor bare.
- C. Bonding Conductor: Copper conductor bare.

## 2.4 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches NPS by 24 inches long concrete pipe with belled end.
- B. Well Cover: Fiberglass with legend "GROUND" embossed on cover.

## 2.5 MECHANICAL CONNECTORS

- A. Manufacturers:
  - 1. Burndy: Part of Hubbell Electrical Systems.
  - 2. ERICO International Corporation.
  - 3. Harger Lightning & Grounding.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

## 2.6 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
  - 1. Cadweld.
  - 2. ERICO International Corporation.
  - 3. Harger Lightning & Grounding.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

### 3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

### 3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

### 3.4 INSTALLATION

- A. Install in accordance with IEEE 142
  - 1. Where sensitive equipment is present, install in accordance with IEEE 1100.
- B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
- C. Install grounding and bonding conductors concealed from view.
- D. Bond together reinforcing steel and metal accessories in water containment structures.
- E. Field verify existing ground grid under existing access floors in the Server Room spaces and field verify bond to each access floor pedestal to grid.
- F. Field verify existing bonding on each metallic raceway, pipe, duct and other metal object entering space under existing access floors. Bond new metallic raceways to underfloor ground grid. Install 2 AWG bare copper bonding conductor.
- G. Equipment Grounding Conductor: Install separate, insulated conductor within each new feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- H. Field verify continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
- I. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- J. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.
- K. Permanently attach equipment and grounding conductors prior to energizing equipment.

### 3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect and test in accordance with NETA ATS, except Section 4.

- D. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- E. Perform ground resistance testing in accordance with IEEE 142.
- F. Perform continuity testing in accordance with IEEE 142.
- G. When improper grounding is found on receptacles, notify the Architect/Engineer and check receptacles/branch circuits in entire project to correct. Perform retest.

END OF SECTION

## SECTION 26 05 29

### HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Conduit supports.
  - 2. Formed steel channel.
  - 3. Spring steel clips.
  - 4. Sleeves.
  - 5. Mechanical sleeve seals.
  - 6. Firestopping relating to electrical work.
  - 7. Firestopping accessories.
  - 8. Equipment bases and supports.

##### 1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
  - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
  - 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- B. FM Global:
  - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- C. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
- D. Underwriters Laboratories Inc.:
  - 1. UL 263 - Fire Tests of Building Construction and Materials.
  - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
  - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
  - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
  - 5. UL - Fire Resistance Directory.
- E. Intertek Testing Services (Warnock Hersey Listed):
  - 1. WH - Certification Listings.



### 1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

### 1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
  - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable codes FM, UL, WH for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.
- C. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- E. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- F. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

### 1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
  - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
  - 2. Firestopping: Submit data on product characteristics, performance, and limitation criteria.

- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly for new construction.
- E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- F. Manufacturer's Installation Instructions:
  - 1. Hangers and Supports: Submit special procedures and assembly of components.
  - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Firestopping Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

## 1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10-inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
  - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
  - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
    - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
  - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
  - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with all applicable standards.
- G. Maintain two copies of each document on site.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience or approved by manufacturer.

## 1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

## 1.11 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when the temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for a minimum of 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

## PART 2 PRODUCTS

### 2.1 CONDUIT SUPPORTS

- A. Manufacturers:
  - 1. ERICO International Corporation.
  - 2. Thomas & Betts Corporation: A Member of the ABB Group.
  - 3. Unistrut: Part of Atkore International.
  - 4. Substitutions: Section 01 60 00 – Product Requirements.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self-locking.
- G. Fastening Hardware including screw, bolts, nuts, washers, etc. shall be stainless steel in outdoor, wet, or damp locations.

## 2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
  1. B-Line, and Eaton Business.
  2. Unistrut: Part of Atkore International.
  3. Substitutions: Section 01 60 00 – Product Requirements.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

## 2.3 SPRING STEEL CLIPS

- A. Manufacturers:
  1. B-line, an Eaton Business.
  2. Minerallac Company.
  3. Morris Products, Inc.
  4. Substitutions: Section 01 60 00 – Product Requirements.
- B. Product Description: Mounting hole and screw closure.

## 2.4 SLEEVES

- A. Furnish materials in accordance with all applicable Federal, State, and Local Codes and Ordinances.
- B. Sleeves for Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- C. Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- D. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed.
- E. Stuffing or Fire-stopping Insulation: Glass fiber type, non-combustible.

## 2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
  - 1. Pipeline Seal and Insulator, Inc.
  - 2. Substitution: Section 01 60 00 – Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

## 2.6 FIRESTOPPING

- A. Manufacturers:
  - 1. 3M Fire Protection Products.
  - 2. Nelson Firestop; a brand of Emerson Industrial Automation.
  - 3. United States Gypsum Company.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
  - 1. Select one or more of the following products. Coordinate with list manufacturers acceptable for this Project.
  - 2. Silicone Firestopping Elastomeric Firestopping: Single or Multiple component silicone elastomeric compound and compatible silicone sealant.
  - 3. Foam Firestopping Compounds: Single or Multiple component foam compound.
  - 4. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
  - 5. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
  - 6. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
  - 7. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
  - 8. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: As selected from manufacturer's full range of colors.

## 2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
  - 1. Mineral fiberboard.
  - 2. Mineral fiber matting.

3. Sheet metal.
  4. Plywood or particle board.
  5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
1. Furnish UL listed products.
  2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
  2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

### 3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing and/or damming materials to arrest liquid material leakage where required.
- D. Obtain permission from Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.

### 3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
  1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.

2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of or recessed into and grouted flush with slab as indicated on drawings.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduits on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
4. Support vertical conduit at every floor.
5. Install hangers and supports as required to support electrical system components adequately and securely, in a neat and workmanlike manner, as specified in NECA 1.
6. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit. Do not fasten to the suspended ceiling grid system.
7. Obtain permission from Architect/Engineer before drilling or cutting structural members.

### 3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit, and other items, requiring firestopping.
- B. Apply primer as recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

- C. Apply firestopping material in sufficient thickness to achieve the required fire and smoke rating, to uniform density and texture.
- D. Where each material is installed:
  - 1. Compress fibered material to maximum 40 percent of its uncompressed size.
  - 2. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
  - 3. Place intumescent coating in sufficient coats to achieve the rating required.
- E. Remove dam material after firestopping material has cured, unless otherwise indicated on drawings.
- F. Fire Rated Surface:
  - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
    - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
    - c. Pack voids with backing material.
    - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
  - 2. Where cable tray, bus, cable bus, conduit, wireway, trough, and other raceways penetrate fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
  - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
    - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
    - c. Install type of firestopping material recommended by manufacturer.
  - 2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below the finished ceiling(s).
  - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
  - 4. Interior partitions: Seal pipe penetrations at each partition between different room types. Apply sealant to both sides of penetration to completely fill the annular space between the sleeve and the conduit.

### 3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.



### 3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing or fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel plastic or stainless-steel escutcheons at finished surfaces.

### 3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect installed firestopping for compliance with specifications and submitted schedule.

### 3.8 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

### 3.9 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

## SECTION 26 05 33

### RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
  - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
  - 3. Section 26 05 53 - Identification for Electrical Systems.
  - 4. Section 26 27 26 - Wiring Devices.

##### 1.2 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
  - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
  - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
  - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

##### 1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground More than 5 feet outside Foundation Wall: Provide rigid steel conduit, plastic coated conduit, or PVC Schedule 40 or 80 nonmetallic conduit.
- C. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit, plastic-coated conduit, or PVC Schedule 40 or 80 nonmetallic conduit.

- D. In or Under Slab on Grade: Provide rigid steel conduit, plastic coated conduit, or PVC Schedule 40 or 80 nonmetallic conduit. Provide cast or nonmetallic metal boxes as noted/required.
- E. Outdoor Locations, Above Grade: Provide rigid steel conduit Provide liquidtight flexible metal conduit for equipment connections. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
- F. In Slab Above Grade: Provide rigid steel conduit, intermediate metal conduit, or PVC Schedule 40 or 80 nonmetallic conduit. Provide sheet metal boxes.
- G. Wet and Damp Locations: Provide rigid steel conduit, plastic coated conduit, PVC Schedule 40 or 80 nonmetallic conduit. Provide liquid-tight flexible metal conduit for equipment connections. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- H. Concealed Dry Locations: Provide rigid steel conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- I. Exposed Dry Locations: Provide rigid steel conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

#### 1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for the following (if applicable):
  1. Flexible metal conduit.
  2. Liquid-tight flexible metal conduit.
  3. Nonmetallic conduit.
  4. Flexible nonmetallic conduit.
  5. Nonmetallic tubing.
  6. Raceway fittings.
  7. Conduit bodies.
  8. Surface raceway.
  9. Wireway.
  10. Pull and junction boxes.
  11. Handholes.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

## 1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record As-Built Documents:
  - 1. Record actual routing of conduits larger than 1 inch.
  - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

## 1.8 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUIT

- A. Manufacturers:
  - 1. Allied Tube & Conduit; a part of Atkore International.
  - 2. EGS/Appleton Electric.
  - 3. Thomas & Betts Corporation; A Member of the ABB Group.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Rigid Aluminum Conduit: ANSI C80.5.
- D. Intermediate Metal Conduit (IMC): Rigid steel.
- E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

### 2.2 PVC COATED METAL CONDUIT

- A. Manufacturers:

1. Plasti-Bond.
  2. Thomas & Betts Corporation; A Member of the ABB Group.
  3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

### 2.3 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
1. AFC Cable Systems; a part of Atkore International.
  2. EGS/Appleton Electric.
  3. Southwire Company.
  4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Interlocked steel construction.
- C. Fittings: NEMA FB 1.

### 2.4 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
1. AFC Cable Systems; a part of Atkore International.
  2. EGS/Appleton Electric.
  3. Southwire Company.
  4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Interlocked steel construction with PVC jacket.
- C. Fittings: NEMA FB 1.

### 2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
1. Carlon; a brand of Thomas & Betts Corporation.
  2. Republic Conduit.
  3. Western Tube and Conduit Corporation.
  4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel, set screw type.

## 2.6 NONMETALLIC CONDUIT

- A. Manufacturers:
  - 1. Carlon; a brand of Thomas & Betts Corporation.
  - 2. EGS/Appleton Electric.
  - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA TC 2; Schedule 40 PVC and Schedule 80 PVC, as required by code.
- C. Fittings and Conduit Bodies: NEMA TC 3.

## 2.7 NONMETALLIC TUBING

- A. Manufacturers:
  - 1. Carlon; a brand of Thomas & Betts Corporation.
  - 2. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA TC 2.
- C. Fittings and Conduit Bodies: NEMA TC 3.

## 2.8 SURFACE METAL RACEWAY

- A. Manufacturers:
  - 1. Niedax Inc.
  - 2. Panduit Corp.
  - 3. Wiremold / Legrand.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- C. Size: Per Code plus additional 25% spare, unless otherwise indicated.
- D. Finish: To be determined (TBD) during shop drawing review. Stainless steel in hazardous locations or where corrosive elements are present.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

## 2.9 SURFACE NONMETAL RACEWAY

- A. Manufacturers:
  - 1. Panduit Corp.
  - 2. Wiremold / Legrand.
  - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Fiberglass channel with fitted cover, suitable for use as surface raceway.

- C. Size: Per Code plus additional 25% spare, unless otherwise indicated.
- D. Finish: To be determined (TBD) during shop drawing review.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories, finish to match raceway.

## 2.10 WIREWAY

- A. Manufacturers:
  1. Carlon; a brand of Thomas & Betts Corporation.
  2. Hoffman; a brand of Pentair Equipment Protection.
  3. Square D; by Schneider Electric.
  4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: General purpose, Oiltight and dust-tight, or Raintight type wireway. Product rating shall match NEMA Rating for enclosures in same location.
- C. Knockouts: Manufacturer's standard. Bottom only in Wet, Damp or Outdoor locations.
- D. Size: 4 x 4 inch, 6 x 6 inch, 8 x 8 inch, and 12 x 12 inch; length as required.
- E. Cover: Hinged or Screw cover with full gaskets.
- F. Connector: Slip-in or Flanged.
- G. Fittings: Lay-in type with removable top, bottom, and side; captive screws and drip shield.
- H. Finish: Rust inhibiting primer coating with gray enamel finish.

## 2.11 OUTLET BOXES

- A. Manufacturers:
  1. Allied Moulded Products, Inc.
  2. Carlon; a brand of Thomas & Betts Corporation.
  3. RACO; Hubbell.
  4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
  1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
  2. Concrete Ceiling Boxes: Concrete type.
- C. Nonmetallic Outlet Boxes: NEMA OS 2.
- D. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.

- F. Wall Plates for Unfinished and Utility/Mechanical Areas: Furnish raised metal or stainless steel.

## 2.12 PULL AND JUNCTION BOXES

- A. Manufacturers:
  - 1. Emerson Process Management; Rosemount Division.
  - 2. Hoffman; a brand of Pentair Equipment Protection.
  - 3. RACO; Hubbell.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- C. Hinged Enclosures: As specified in Section 26 27 16.
- D. Surface Mounted Cast Metal Box: NEMA 250, Type 4, 4X or 6 (per environmental conditions); flat-flanged, surface mounted junction box:
  - 1. Material: Galvanized cast iron.
  - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

### 3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.



### 3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

### 3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route exposed raceway vertically in room corners and horizontally along wall/ceiling edges or trim pieces. All routing of exposed raceway within finished spaces shall be approved by Architect/Engineer prior to installation.
- J. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- K. Route conduit in and under slab from point-to-point.
- L. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab.
- M. Maintain clearance between raceway and piping for maintenance purposes.
- N. Maintain 12-inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- O. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- P. Bring conduit to shoulder of fittings; fasten securely.

- Q. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for a minimum of 20 minutes.
- R. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- S. Install no more than equivalent of three 90-degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2-inch size.
- T. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- U. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- V. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- W. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- X. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- Y. Close ends and unused openings in wireway.

### 3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device, unless indicated on Drawings.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

### 3.6 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with all State and Local Code Requirements and Standards.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation as required.
- C. Locate outlet boxes to allow luminaires to be positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

### 3.7 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

### 3.8 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore the finish.

END OF SECTION

## SECTION 26 05 53

### IDENTIFICATION FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Nameplates.
  - 2. Labels.
  - 3. Wire markers.
  - 4. Conduit markers.
  - 5. Lockout Devices.
- B. Related Sections:
  - 1. Section 09 90 00 - Painting and Finishes: Execution requirements for painting specified by this section.

##### 1.02 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data:
  - 1. Submit manufacturer's catalog literature for each product required.
  - 2. Submit an electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- C. Samples (upon request):
  - 1. Submit one sample of each type of identification products that are applicable to the project.
  - 2. Submit one nameplate, 4 x 4 inch in size illustrating materials and engraving quality.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

##### 1.03 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record As-Built Documents: Record actual locations of tagged devices; include tag numbers.

##### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with all applicable Federal, State, and local code and ordinances.

## 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience or approved by manufacturer.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

## 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

## 1.08 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish a container of any spray-on adhesives used.

## PART 2 - PRODUCTS

### 2.01 NAMEPLATES

- A. Manufacturers:
  - 1. Craftmark Pipe Markers.
  - 2. Kolbi Pipe Marker Co.
  - 3. Seton Identification Products.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Laminated three-layer plastic with engraved white or black letters on a contrasting black or white background color, unless otherwise indicated.

- C. Letter Size:
  - 1. 1/8 inch high letters for identifying individual equipment and loads.
  - 2. 1/4 inch high letters for identifying grouped equipment and loads.
  - 3. Minimum 1/8 inch high letters for identifying any required information, not otherwise specified.
- D. Minimum nameplate thickness: 1/8 inch.

## 2.02 LABELS

- A. Manufacturers:
  - 1. Brady ID.
  - 2. Seton Identification Products.
  - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Labels: Embossed adhesive tape, with 3/16 inch white or black letters on a contrasting black or white background.

## 2.03 WIRE MARKERS

- A. Manufacturers:
  - 1. Brady ID.
  - 2. Grafoplast Wire Markers.
  - 3. Ideal Industries, Inc.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: Cloth tape, split sleeve, or tubing type wire markers.
- C. Legend:
  - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
  - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams. Where shop drawings indicate a different labeling methodology at the same location, EACH wire shall bear BOTH labels for clarity.
  - 3. Communication Cables: Communication and cable type using industry standard designations or as indicated on Drawings.

## 2.04 CONDUIT AND RACEWAY MARKERS

- A. Manufacturers:
  - 1. Brady ID.
  - 2. Ideal Industries, Inc.
  - 3. Seton Identification Products.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description:
  - 1. Where susceptible to mechanical damage: Nameplate fastened with straps.

2. With flat smooth surface not susceptible to mechanical damage: Nameplate fastened with adhesive.
3. Without flat smooth surface: Labels fastened with adhesive.

C. Color:

1. Medium Voltage System: Black lettering on white background.
2. 480 Volt System: Black lettering on white background.
3. 208/240 Volt Systems: Black lettering on white background.
4. All other Systems: Black lettering on white background.

D. Legend:

1. Medium Voltage System: HIGH VOLTAGE.
2. 480 Volt System: 480 VOLTS.
3. 240 Volt System: 240 VOLTS.
4. 240 Volt – 3 Phase System: 240 VOLTS 3Ø – HIGH-LEG
5. 208 Volt System: 208 VOLTS.
6. Instrumentation & Controls: I & C.
7. Communications: COMMUNICATIONS

## 2.05 UNDERGROUND WARNING TAPE

A. Manufacturers:

1. Brady ID.
2. Kolbi Pipe Marker Co.
3. Seton Identification Products.
4. Substitutions: Section 01 60 00 - Product Requirements.

- B. Description: 4-inch-wide plastic tape, detectable type, colored red or yellow, based on warning type, with suitable warning legend describing buried electrical lines.

## 2.06 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:
  - a. Brady ID.
  - b. Master Lock Company, LLC.
  - c. Substitutions: Section 01 60 00 - Product Requirements.
2. Anodized aluminum with erasable label surface; size minimum 7-1/4 x 3 inches.
  - a. Reinforced nylon hasp may be allowed in hazardous or corrosive locations per Engineer's approval.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

### 3.02 EXISTING WORK

- A. Install identification on existing electrical equipment to remain in accordance with this section.
- B. Install identification on unmarked existing equipment and materials associated with proposed work.
- C. Replace lost nameplates, labels, and markers.

### 3.03 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
  - 1. Install nameplate parallel to equipment lines.
  - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
  - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
  - 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
    - a. Screws shall be Standard or Philips type.
    - b. Rivets must be approved by the Engineer prior to purchase and installation.
  - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
  - 6. Install nameplates for the following:
    - a. Switchboards.
    - b. Panelboards.
    - c. Transformers.
    - d. Service Disconnects.
    - e. Local Disconnects and Combination Motor Starter Disconnects
    - f. Automatic Transfer Switches
    - g. Control Cabinets.
    - h. Remote Instrumentation and Control Enclosures.
    - i. Terminal Boxes.
- C. Label Installation:
  - 1. Install label parallel to equipment lines.
  - 2. Install label for identification of individual control device stations.
  - 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
  - 1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
  - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
  - 3. Install labels at data outlets identifying patch panel and port designation.
    - a. If otherwise indicated on Drawings, BOTH designations shall be labeled.



- E. Conduit and Raceway Marker Installation:
  - 1. Install Conduit and Raceway marker for each concealed and accessible Conduit and Raceway longer than 6 feet.
  - 2. Conduit and Raceway Marker Spacing: 20 feet on-center.
  
- F. Underground Warning Tape Installation:
  - 1. Install underground warning tape along the length of each underground conduit, raceway, or cable of all feeder or service entrance conductors and raceways, 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

## SECTION 26 24 16

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Distribution and branch circuit panelboards.
- B. Related Requirements:
  - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 2. Section 26 05 53 - Identification for Electrical Systems.

##### 1.2 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers:
  - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
  - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
  - 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
  - 3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
  - 4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  - 5. NEMA PB 1 - Panelboards.
  - 6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
- E. UL:
  - 1. UL 50 - Cabinets and Boxes
  - 2. UL 67 - Safety for Panelboards.
  - 3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
  - 4. UL 1283 - Electromagnetic Interference Filters.
  - 5. UL 1449 - Transient Voltage Surge Suppressors.
  - 6. UL 1699 - Arc-Fault Circuit Interrupters.

### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit catalog data showing specified features of standard products.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker, and fusible switch arrangement and sizes.
- D. Source Quality Control Submittals: Indicate results of shop or factory tests and inspections.
- E. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

### 1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance products.
- B. Extra Stock Materials:
  - 1. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

### 1.6 QUALITY ASSURANCE

- A. Qualifications
  - 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

## PART 2 - PRODUCTS

### 2.1 DISTRIBUTION PANELBOARDS

- A. Manufacturers:
  - 1. Eaton.
  - 2. Siemens Industry, Inc.
  - 3. Square D; by Schneider Electric.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: NEMA PB 1, circuit breaker type panelboard; fusible switch type where indicated. Furnish combination controllers as indicated on Drawings.

C. Operation:

1. Service Conditions:
  - a. Temperature: Under 104 degrees F.
  - b. Altitude: 1,000 feet above sea level.
2. Minimum integrated short circuit rating: 10,000 A rms symmetrical for 240 or 208 V panelboards; 65,000 A rms symmetrical for 480 V panelboards, or as indicated on Drawings. **CAUTION** – Field verify all short circuit current ratings with the electric utility and the Engineer prior to ordering electrical power distribution equipment.

D. Materials

1. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
2. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Furnish interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate NEMA FU 1, Class R or J fuses.
3. Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
4. Molded Case Circuit Breakers with Current Limiters: UL 489, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
5. Current Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical A, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
6. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic or solid-state controller for induction motors rated in horsepower.
  - a. Two-Speed Controllers: Include integral time delay transition between FAST and SLOW speeds.
  - b. Full-Voltage Reversing Controllers: Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.
  - c. Control Voltage: 120 volts, 60 Hertz.
  - d. Overload Relay: NEMA ICS 2; bimetal.
    - 1) Melting alloy, per Engineer approval.
  - e. Auxiliary Contacts: NEMA ICS 2, two each field convertible contacts in addition to seal-in contact.
  - f. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type.
  - g. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
  - h. Pushbuttons: Recessed type.
  - i. Indicating Lights: LED type.
  - j. Selector Switches: Rotary type.
  - k. Relays: NEMA ICS 2, Minimum of Two Poles, Double-Throw (DPDT).
  - l. Control Power Transformers: 120 V secondary, 500 VA minimum, in each motor starter as indicated on Drawings. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
7. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.
8. Surge Suppressers: Externally mounted to panelboard; refer to Section 26 35 53.
9. Enclosure: NEMA PB 1, Type 1 (indoor) 3R (outdoor), cabinet box. Dimensions as required for wiring and equipment, unless indicated on Drawings.

10. Cabinet Front: Surface door-in-door type, fastened with concealed trim clamps, screws, hinge and latch, or hinged door with flush lock, and metal directory frame.

E. Finishes:

1. Manufacturer's standard gray enamel.

## 2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:

1. Eaton.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Description: NEMA PB1, circuit breaker type, lighting, and appliance branch circuit panelboard.

C. Materials:

1. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard; furnish insulated ground bus as indicated on Drawings.
2. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.
3. Minimum Integrated Short Circuit Rating: 10,000 A rms symmetrical for 240 V panelboards; 65,000 S rms symmetrical for 480 V panelboards, or as indicated on Drawings. CAUTION – Field verify all short circuit current ratings with the electric utility and the engineer prior to ordering electrical power distribution equipment.
4. Molded Case Circuit Breakers: UL 489, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Provide UL class 760 arc-fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
5. Current Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical A, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
6. Surge Suppressors: Externally mounted to panelboard; refer to Section 26 35 53.
7. Enclosure: NEMA PB 1, Type 1 (Indoor), Type 3R (Outdoor).
8. Cabinet Box: Minimum 6 inches deep.

D. Cabinet Front: Flush or Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finishes:

1. Finish in manufacturer's standard gray enamel.

E. Enclosure:

1. Indoor and Dry Locations: General Purpose, Type 1.
2. Outdoor, Wet, or Damp Locations: Rainproof, Type 3R

## 2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

## PART 3 - EXECUTION

### 3.1 DEMOLITION

- A. Disconnect abandoned panelboards and load centers. Install blank cover for abandoned panelboards and load centers.
- B. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.

### 3.2 INSTALLATION

- A. Install panelboards according to NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect project as-builts and existing conditions confirmed during construction. Identify each circuit as to its clear, evident and specific purpose of use.
- G. Install engraved plastic nameplates according to Section 26 05 53.
- H. Install a minimum of three (3) spare conduits out of each new recessed panelboard to accessible location above ceiling or below floor. Minimum spare conduits: 25%, empty 1 inch. Identify each as spare.
- I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels according to NFPA 70.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

### 3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Inspect and test according to NETA ATS, except Section 4.

- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean existing panelboards and load centers to remain or to be reinstalled.

END OF SECTION

## SECTION 26 28 13

### FUSES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fuses.

##### 1.2 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:
  - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

##### 1.5 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials
- B. Spare Parts:
  - 1. Furnish two fuse pullers.
- C. Extra Materials:
  - 1. Furnish three spare fuses of each Class, size, and rating installed.

##### 1.6 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers:
  - 1. Bussmann, an Eaton business.
  - 2. Substitutions: Section 01 60 00 - Product Requirements.

### 2.2 DESIGN REQUIREMENTS

- A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.
- B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

### 2.3 FUSES PERFORMANCE REQUIREMENTS

- A. Main Service Switches Larger than 600 amperes: Class L (time delay).
- B. Main Service Switches: Class RK1 (time delay). RK5. J (time delay).
- C. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).
- D. Power Load Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- E. Motor Load Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- F. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.
- G. Lighting Load Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- H. Other Feeder Switches Larger than 600 amperes: Class L time delay.
- I. Other Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- J. General Purpose Branch Circuits: Class RK1 (time delay). RK5. J (time delay).
- K. Motor Branch Circuits: Class RK1 (time delay). RK5. J (time delay).
- L. Lighting Branch Circuits: Class G.

### 2.4 FUSES

- A. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

- 2.5 CLASS RK1 (TIME DELAY) FUSES
  - A. Dimensions and Performance: NEMA FU 1.
  - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.6 CLASS RK1 (NON-TIME-DELAY) FUSES
  - A. Dimensions and Performance: NEMA FU 1.
  - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.7 CLASS RK5 FUSES
  - A. Dimensions and Performance: NEMA FU 1.
  - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.8 CLASS J (TIME DELAY) FUSES
  - A. Dimensions and Performance: NEMA FU 1.
  - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.9 CLASS J (NON-TIME-DELAY) FUSES
  - A. Dimensions and Performance: NEMA FU 1.
  - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.10 CLASS T FUSES
  - A. Dimensions and Performance: NEMA FU 1.
  - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.11 CLASS L (FAST-ACTING) FUSES
  - A. Dimensions and Performance: NEMA FU 1.
  - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.12 CLASS L (TIME DELAY) FUSES
  - A. Dimensions and Performance: NEMA FU 1.
  - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.13 CLASS G FUSES
  - A. Dimensions and Performance: NEMA FU 1.

- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install fuse with label oriented so manufacturer, type, and size are easily read.

END OF SECTION

## SECTION 26 28 16.16

### ENCLOSED SWITCHES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Non-fusible switches.
- B. Related Requirements:
  - 1. Section 26 05 29 - Hangers and Supports for Electrical Systems.
  - 2. Section 26 05 53 - Identification for Electrical Systems.
  - 3. Section 26 28 13 - Fuses.

##### 1.2 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:
  - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
  - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit switch ratings and enclosure dimensions.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

##### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

#### PART 2 - PRODUCTS

##### 2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
  - 1. Square D; by Schneider Electric.
  - 2. Eaton.

3. Siemens Power Transmission & Distribution, Inc.
  4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Operation:
1. Switch Ratings
    - a. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
    - b. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere). 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 amperes).
- D. Materials:
1. Fuse clips: Designed to accommodate NEMA FU 1 fuses.
    - a. Fuse Class to match required application.
  2. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
    - a. Interior Dry Locations: Type 1.
    - b. Exterior Locations: Type 3R or 4.
    - c. Industrial Locations: Type 4X.
    - d. Classified Locations: Type 4X.
  3. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
  4. Furnish switches with entirely copper current carrying parts.
  5. Heavy-duty rated.

## 2.2 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
1. Square D; by Schneider Electric.
  2. Eaton.
  3. Siemens Power Transmission & Distribution, Inc.
  4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Operation:
1. Switch Ratings
    - a. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
    - b. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere). 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 amperes).

D. Materials:

1. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
  - a. Interior Dry Locations: Type 1.
  - b. Exterior Locations: Type 3R or 4.
  - c. Industrial Locations: Type 4X.
  - d. Classified Locations: Type 4X.
2. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
3. Furnish switches with entirely copper current carrying parts.
4. Heavy-duty rated.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install enclosed switches where indicated.
- B. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 feet to operating handle.
- D. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53. Engrave nameplates with the equipment served and the panel and circuit number supplying the switch.
- F. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

#### 3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

#### 3.3 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

END OF SECTION

## SECTION 26 32 13

### ENGINE GENERATORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes engine generator set, exhaust silencer and fittings, automatic transfer switch, fuel fittings, battery, and charger.
- B. Related Sections:
  - 1. Section 22 63 00 - Natural-Gas Piping: Product and execution requirements for gas piping to the gas utility meter and generator, as well as for gas piping within 5 feet of building.
  - 2. Section 260526 - Grounding and Bonding for Electrical Systems.
  - 3. Section 260553 - Identification for Electrical Systems.

##### 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
  - 3. NEMA MG 1 - Motors and Generators.
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NFPA:
  - 1. NFPA 30 - Flammable and Combustible Liquids Code.
- D. UL:
  - 1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

##### 1.3 SYSTEM DESCRIPTION

- A. Basis of Design Capacity: Basis of design 175 kW, 200 kVA at elevation of 1,000 feet above sea level standby rating using specified engine cooling scheme.

#### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Include plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.
- C. Product Data: Submit data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, transfer switch, battery, battery rack, battery charger, exhaust silencer, vibration isolators, and radiator.
- D. Sizing Reports: Provide a manufacturer-sizing report based on the existing maximum demands recorded from the electric utility and the three-phase loads as required. Include a minimum of 4 steps. Coordinate with the engineer.
- E. Test Reports: Indicate results of performance testing.
- F. Manufacturer's Field Reports: Indicate inspections, findings, and recommendations.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions and service manuals for normal operation, routine maintenance, oil sampling and analysis for engine wear, and emergency maintenance procedures.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum of three years' documented experience, and with service facilities within 100 miles of project.
- B. Supplier: Authorized distributor of a specified manufacturer with minimum three years of documented experience.

#### 1.7 WARRANTY

- A. Section 017000 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty.

#### 1.8 MAINTENANCE SERVICE

- A. Section 017000 - Execution and Closeout Requirements: Maintenance service.



- B. Furnish service and maintenance of engine generator and transfer switch for one year from Date of Substantial Completion.

## 1.9 MAINTENANCE MATERIALS

- A. Section 017000 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of tools required for preventative maintenance of engine generator system. Package tools in adequately sized metal toolbox.
- C. Furnish two of each fuel, oil and air filter element.

## PART 2 - PRODUCTS

### 2.1 SERVICE CONDITIONS

- A. Temperature: 0 - 122 degrees F.
- B. Altitude: 1,000 feet.
- C. Other Unusual Service Conditions: None.

### 2.2 ENGINE

- A. Manufacturers:
  - 1. Cummins Power Generation.
  - 2. Kubota Engine America Corp.
  - 3. MTU Onsite Energy Corporation.
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Product Description: Water-cooled in-line or V-type, four-stroke cycle, electric ignition internal combustion engine.
- D. Rating: Sufficient to operate under 10 percent overload for one hour in ambient of 122 degrees F at elevation of 1,000 feet
- E. Fuel System: Natural gas.
- F. Engine speed: 1800 rpm.
- G. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.
- H. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Furnish remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.

- I. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 volts AC.
- J. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.
- K. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Furnish fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.
- L. Mounting: Furnish unit with suitable spring-type vibration isolators and mount on structural steel base.

## 2.3 GENERATOR

- A. Manufacturers:
  - 1. Generac Industrial
  - 2. Cummins Power Generation.
  - 3. Caterpillar
  - 4. Kohler Power Generation
- B. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Product Description: NEMA MG1, three phase, six pole, reconnectable brushless synchronous generator with brushless exciter.
- D. Basis of Design Rating: 200 kW, 250 kVA, at 0.8 power factor, 480Y/277 volts, 60 Hz at 1800 rpm.
- E. Insulation Class: F.
- F. Temperature Rise: 130 degrees C Standby.
- G. Enclosure: NEMA MG-1, Weatherproof, Type 2 Sound Attenuated.
- H. Voltage Regulation: Furnish generator mounted volts per hertz exciter-regulator to match engine and generator characteristics, with voltage regulation plus or minus 1 percent from no load to full load. Furnish manual controls to adjust voltage droop, voltage level (plus or minus 5 percent) and voltage gain.

## 2.4 GOVERNOR

- A. Manufacturers:
  - 1. Generac Industrial
  - 2. Cummins Power Generation.
  - 3. Caterpillar

4. Kohler Power Generation

- B. Substitutions: Section 01 60 00 - Product Requirements.
- C. Product Description: Electronic Isochronous governor to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

2.5 AUTOMATIC TRANSFER SWITCH

- A. Manufacturers:
  - 1. ASCO Power Technologies.
  - 2. Generac Industrial
  - 3. Cummins Power Generation
  - 4. Kohler Power Systems.
- B. Substitutions: Section 01 60 00 - Product Requirements.
- C. Product Description: NEMA ICS 10, automatic transfer switch.
- D. Configuration: Electrically operated, mechanically held transfer switch. Service Entrance Rated as required on the Electrical Riser Diagram.
- A. Interrupting Capacity: 125 percent of continuous rating.
- A. Withstand Current Rating: per manufacturer's recommendation when used with molded case circuit breaker.
- B. Control Features and Functions:
  - 1. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, switch position.
  - 2. Test Switch: Mount in cover of enclosure to simulate failure of normal source.
  - 3. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate source to normal source.
  - 4. Transfer Switch Auxiliary Contacts: 1 normally open; 1 normally closed.
  - 5. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 Hertz from rated nominal value.
  - 6. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 Hertz from rated nominal value.
  - 7. In-Phase Monitor: Inhibit transfer until source and load are within 3 Hertz from rated nominal value.
  - 8. Switched Neutral: N/A.
- C. Automatic Sequence of Operation:

1. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
  1. Time Delay To Start Alternate Source Engine Generator: 0 to 120 seconds, adjustable.
  2. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
  3. Time Delay Before Transfer to Alternate Power Source: 0 to 120 seconds, adjustable.
  4. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.
  5. Time Delay Before Transfer to Normal Power: 0 to 30 minutes, adjustable; bypass time delay in event of alternate source failure.
- D. Time Delay Before Engine Shut Down: Zero to 30 minutes, adjustable, of unloaded operation.
- E. Engine Exerciser: Start engine every 7, 14, or 30 days (per Owner's selection); run for 30 minutes before shutting down. Bypass exerciser control when normal source fails during exercising period.
- F. Alternate System Exerciser: Transfer load to alternate source during engine exercising period.
- G. Enclosure:
1. Enclosure: ICS 10
  2. Indoor: Type 1
  3. Outdoor: Type 3R or 4X
  4. Finish: Manufacturer's standard enamel. Color to be determined during shop drawing review.

## 2.6 ACCESSORIES

- A. Exhaust Silencer: With muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions.
- B. Batteries: Heavy duty, starting type lead-acid storage batteries, 170 ampere-hours minimum capacity. Match battery voltage to starting system. Furnish cables and clamps.
- C. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.
- D. Battery Charger: Current limiting type designed to float at 2.17 volts for each cell and equalize at 2.33 volts for each cell. Furnish overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Furnish wall mounted enclosure to meet NEMA 250, Type 1 requirements.
- E. Line Circuit Breaker(s): UL 489, molded case circuit breaker(s) on generator output with integral thermal and instantaneous magnetic trip in each pole. Furnish battery voltage operated shunt trip, connected to open circuit breaker on engine failure. Unit mount in enclosure to meet NEMA 250, Type 1 requirements.
- F. Engine-Generator Control Panel: NEMA 250, Type 1 generator-mounted panel enclosure with engine and generator controls and indicators. Furnish provision for padlock and the following equipment and features:
1. Frequency Meter: 45-65 Hz. range, 3.5 inch dial.
  2. AC Output Voltmeter: 3.5 inch dial, 2 percent accuracy, with phase selector switch.

3. AC Output Ammeter: 3.5 inch dial, 2 percent accuracy, with phase selector switch.
4. Output voltage adjustment.
5. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
6. Engine start/stop selector switch.
7. Engine running time meter.
8. Oil pressure gage.
9. Water temperature gage.
10. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
11. Remote Alarm Contacts: Factory wire SPDT contacts to terminal strip for remote alarm functions.

- G. Weather-protective Enclosure: Reinforced steel housing allowing access to control panel and service points, with lockable doors and panels. Furnish fixed louvers, battery rack, and silencer.

## 2.7 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.

## PART 3 - EXECUTION

### 3.1 EXISTING WORK

- A. Disconnect and remove abandoned engine-generator assemblies and accessories.

### 3.2 INSTALLATION

- A. Install engraved plastic nameplates in accordance with Section 26 05 53.
- B. Ground and bond generator and other electrical system components in accordance with Section 26 05 26.

### 3.3 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements & 017000 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.22.

### 3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Manufacturer's field services.

- B. Prepare and start up engine-generator assembly.

### 3.5 ADJUSTING

- A. Section 017000 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust generator output voltage and engine speed to meet specified ratings.

### 3.6 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Final cleaning.
- B. Clean engine and generator surfaces. Replace oil and fuel filters with new.

### 3.7 DEMONSTRATION AND TRAINING

- A. Furnish a minimum of 4-hours of instruction for multiple people to be conducted at project site with manufacturer's representative.
- B. Describe loads connected to optional-standby system and restrictions for future load additions.
- C. Simulate power outage by interrupting normal source, and demonstrate system operates to provide optional-standby power.
  - 1. Verify functionality of alarm and shutdown signals by simulating conditions.

END OF SECTION

## SECTION 28 31 00

### EXTENSION OF THE EXISTING FIRE DETECTION AND ALARM SYSTEM

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This Section of the specification is for the extension of the existing fire detection and alarm system and includes the extension, connection, and testing of new fire detection and alarm devices to an existing microprocessor controlled, intelligent reporting fire alarm equipment to maintain a complete, operative, coordinated system. It is the intention of this specification that the extension of the existing fire detection and alarm system be provided complete and code compliant. No extra compensation will be given for code compliance. The devices shown on the drawings are for reference only for coordination.
- B. The extension of the existing fire detection and alarm system shall comply with requirements of 2007 NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- C. The fire detection and alarm system manufacturer shall be of the highest caliber and insist on the highest quality. The system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
- D. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).
- E. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall comply the UL listing.
- F. The installation company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the system's integrity.

##### 1.2 SCOPE

- A. The existing intelligent reporting, microprocessor-controlled fire detection and alarm system shall be extended/reconfigured in accordance to the project specifications and drawings.
- B. Basic Performance:
  - 1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on Class B Signaling Line Circuits (SLC).
  - 2. Initiation Device Circuits (IDC) shall be wired Class B as part of an addressable device connected to the by the SLC circuit.
  - 3. Notification Appliance Circuits (NAC) shall be wired Class B as part of an addressable device connected by the SLC circuit or a panel circuit.

- C. Basic System Functional Operation: When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:
1. The system alarm LED on the FACP shall flash.
  2. A local piezo electric signal in the control panel shall sound.
  3. The display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location.
  4. The system shall be capable of printing on the FACP the history information, along with time and date of occurrence.
  5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs shall be activated.
    - a. Light Strobes
    - b. Sound horn/speakers
    - c. Release doors
    - d. Shut-down Air-Handlers
    - e. Close smoke dampers
  6. Alarm signals arriving at the main FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

### 1.3 SUBMITTALS

A. General:

1. Refer to Section 26 00 00 for directions and quantities.
2. The fire detection and alarm contractor shall submit plan review shop drawings along with the complete code compliant fire alarm system layout and drawings. This submittal shall occur no later than 30 days from receipt of contract.
3. The fire detection and alarm contractor shall revise the existing fire detection and alarm system and layout drawings per response to the plan review. The fire detection and alarm contractor shall submit these revised layout drawings as a shop drawing.
4. The fire detection and alarm contractor shall supply all rough-in locations for the revised fire detection and alarm system layout drawings to the electrical contractor in a timely manner. All revisions required by the Office of Fire Safety shall be made prior to the installation of device rough-ins. All costs associated with additional rough-ins and relocation of devices in accordance with the requirements of the Bureau of Fire Services shall be the responsibility of the fire alarm contractor. The costs include but are not limited to the masonry cutting and patching, painting, and cleanup.
5. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.



2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts. Equipment and devices shown on Architectural/Engineering drawings are for reference only. It is the responsibility of the installing contractor/manufacturer to be 100% code compliant. No extra costs will be accepted to provide a code compliant fire alarm system matched with the distributed architectural floor plans.
3. Show annunciator layout, configurations, and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of the operation that gives, in detail, the information required to properly operate the equipment and system.

#### 1.4 GUARANTEE

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one-year period shall be included in the submittal bid.

#### 1.5 APPLICABLE STANDARDS

- A. The specifications and standards listed below form a part of this specification. The system shall comply with the latest standard as applicable.

B. National Fire Protection Association (NFPA):

No. 13	Sprinkler Systems
No. 17A	Wet Chemical Extinguishing Systems
	Clean Agent Extinguishing Systems
No. 72-2012	National Fire Alarm Code
No. 101	Life Safety Code

C. Underwriters Laboratories Inc. (UL):

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective
No. 464	Audible Signaling Appliances

No. 38	Manually Actuated Signaling Boxes
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances

D. Local and State Building Codes.

E. All requirements of the Authority Having Jurisdiction (AHJ).

## 1.6 APPROVALS

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

1. UL Underwriters Laboratories Inc.
2. FM Factory Mutual

B. The fire alarm control panel shall meet UL Standard 864 (Control Units) and UL Standard 1076 (Proprietary Burglar Alarm Systems).

C. The system shall be listed by the national agencies as suitable for extinguishing release applications.

D. Pre-Approved Manufacturers shall match existing system.

## PART 2 – PRODUCTS

### 2.1 EQUIPMENT AND MATERIAL, GENERAL

A. All equipment and components added to the system shall be new, unless otherwise noted, and the manufacturer's current model. The materials, appliances, equipment, and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations.

### 2.2 CONDUIT AND WIRE

A. Conduit:

1. Conduit shall be in accordance with the National Electrical Code (NEC), local and state requirements.

2. Where possible, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of the interior cross-sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760.29.
4. Conduit shall be ¾ inch (19.1 mm) minimum.

B. Wire:

1. All fire alarm system wiring added to the system shall be new.
2. The wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
5. All field wiring shall be completely supervised.
6. All exposed wiring and cable shall be plenum rated as required.

C. Terminal Boxes, Junction Boxes and Cabinets: All boxes and cabinets shall be Listed and Labeled for their use and purpose.

D. Initiating circuits shall be arranged to serve similar categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. All new fire detection and alarm control panels and/or new booster power supplies shall be connected to a separate dedicated branch circuit, maximum 20 amperes. Field coordinate 120VAC power requirements with the Engineer and the Electrical Contractor.

## 2.4 SYSTEM COMPONENTS

- A. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

## 2.5 SYSTEM COMPONENTS – ADDRESSABLE DEVICES

A. Addressable Devices – General

1. Addressable devices shall use simple to install and maintained type address switches. Electronically addressed devices are preferred.

2. Detectors shall be intelligent (analog) and addressable and shall connect with two wires to the fire alarm control panel signaling line circuits.
3. Addressable smoke and thermal detectors shall provide alarm and power/polling LEDs. LED(s) shall flash under normal conditions and LED(s) shall be placed into steady illumination by the control panel, indicating an alarm condition.
4. Smoke detector sensitivity shall be set in the fire alarm control panel and shall be adjustable in the field through the field programming of the system. Distributed intelligence devices are accepted and preferred.
5. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
6. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
7. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector. Systems which utilize distributed intelligence are accepted and preferred.
8. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
9. A magnetic test switch shall be provided to test each detector for 100% obscuration, reported to the FACP.

**B. Intelligent Duct Smoke Detector**

1. The in-duct smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action is taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

**C. Addressable Dry Contact Monitor Module**

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel's SLC loops.
2. The monitor module shall be mounted in a 4-inch square, 2-1/8-inch-deep electrical box, minimum (anything less is acceptable).
3. The IDC zone may be wired for Style D operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
4. For difficult to reach areas, the monitor module shall be available in a miniature package

and shall be no larger than 2-3/4 inch x 1-1/4 inch x 1/2 inch. This version does not need to include Style D or an LED.

## PART-3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that products and systems receiving devices are ready for installation.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Existing Work:
  - 1. Remove exposed abandoned fire detection and alarm wiring, including abandoned wiring above accessible ceiling finishes, back to source.
  - 2. Cut cable flush with walls and floors, and patch surfaces.
  - 3. Disconnect and remove abandoned fire-alarm equipment.
  - 4. Access:
    - a. Maintain access to existing fire detection and alarm equipment and other installations remaining active and requiring access.
    - b. Modify installation or provide access panels as required in inaccessible locations.
  - 5. Extend existing fire detection and alarm installations using materials and methods as specified.
  - 6. Clean and repair existing fire detection and alarm equipment that is to remain or to be reinstalled.

### 3.2 INSTALLATION

- C. Install 14-AWG minimum size conductors for fire-alarm detection and signal circuit conductors in conduit.
- D. Mount end-of-line devices in control panels as required.
- E. Connect conduit and wire to new duct smoke detectors.
- F. Automatic Detector Installation: Comply with NFPA 72.
- G. Ground and bond fire detection and alarm equipment and circuits as specified in Section 26 05 26 - Grounding and Bonding for Electrical Systems.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

- B. Test fire detection and alarm devices and systems according to NFPA 72 and local fire department requirements.
- C. Manufacturer Services: Furnish services of certified manufacturer's representative experienced in installation of products furnished under this Section for not less than 4 hours on Site for installation, inspection, startup, field testing, adjustments, and instructing Owner's personnel in maintenance of equipment.
- D. Equipment Acceptance:
  - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
  - 2. Make final adjustments to equipment under the direction of manufacturer's representative.
- E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

#### 3.4 DEMONSTRATION AND TRAINING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel. Demonstration shall be a minimum of 4-hours and Owner/Engineer shall be given a minimum 3-day notice.

#### 3.5 MAINTENANCE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.
- B. Provide service and maintenance of fire-detection and alarm equipment for one year from date of Substantial Completion.

END OF SECTION

SECTION 31 05 13  
SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Subsoil materials.
  - 2. Topsoil materials.
  
- B. Related Sections:
  - 1. Section 31 05 16 - Aggregates for Earthwork.
  - 2. Section 31 22 13 - Rough Grading.
  - 3. Section 31 23 17 - Trenching.
  - 4. Section 31 23 23 - Fill.
  - 5. Section 32 91 19 - Landscape Grading.
  - 6. Section 32 92 19 - Seeding and Soil Supplements.
  - 7. Section 33 46 00 - Subdrainage: Filter aggregate.
  - 8. Section 31 25 00 - Erosion and Sedimentation Controls: Slope protection and erosion control.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
  
- B. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3  - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3  - 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).</sup></sup>

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
  
- B. Samples: Maybe requested for submittal by the Engineer for testing. Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.
  
- C. Materials Source: Submit name of imported materials source.
  
- D. Manufacturer's Certificate: Certify soils meet or exceed specified requirements.

## 1.4 QUALITY ASSURANCE

- A. Furnish each subsoil and topsoil material from single source throughout the Work. A second source maybe requested for approval by the Engineer.
- B. Perform Work in accordance with State of Michigan Department of Transportation standard specifications for construction.

## PART 2 PRODUCTS

### 2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1: Native material conforming to State of Michigan Department of Transportation standard specifications for construction.
- B. Subsoil Type S2:
  - 1. Native material.
  - 2. Graded.
  - 3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.

### 2.2 TOPSOIL MATERIALS

- A. Topsoil Type S3: Native material conforming to State of Michigan Department of Transportation standard specifications for construction.
- B. Topsoil Type S4:
  - 1. Native Topsoil.
  - 2. Graded.
  - 3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
    - a. Screening: Double screened.
- C. Topsoil Type S5:
  - 1. Imported borrow.
  - 2. Friable loam.
  - 3. Reasonably free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds, and foreign matter.
    - a. Screening: Double screened.
  - 4. Acidity range (pH) of 5.5 to 7.5.
  - 5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

### 2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services Testing and analysis of soil material.
- B. Testing and Analysis of Subsoil Material: Perform in accordance with AASHTO T180.
- C. Testing and Analysis of Topsoil Material: Perform in accordance with AASHTO T180.



- D. When tests indicate materials do not meet specified requirements, change material and retest.
- E. Furnish materials of each type from same source throughout the Work.

## PART 3 EXECUTION

### 3.1 EXCAVATION

- A. Excavate subsoil and topsoil as required for utility and/or road installation. Strip topsoil to full depth of topsoil for complete installation.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials subsoil and topsoil not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

### 3.2 STOCKPILING

- A. Stockpile materials on site at locations approved by the Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Stockpile topsoil 8 feet high maximum.
- E. Prevent intermixing of soil types or contamination.
- F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- G. Stockpile unsuitable or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

### 3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00  
SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Removing surface debris.
  - 2. Removing designated paving, curbs, and sidewalk.
  - 3. Removing designated trees, shrubs, and other plant life.
  - 4. Removing abandoned utilities.
  - 5. Excavating topsoil.
  
- B. Related Sections:
  - 1. Section 31 22 13 - Rough Grading.
  - 2. Section 31 23 16 - Excavation.
  - 3. Section 31 25 00 - Soil Erosion and Sedimentation Control.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Site Clearing:
  - 1. Basis of Measurement: Included in the unit price bid for utility being installed.
  - 2. Basis of Payment: Includes clearing site, loading and removing waste materials from site, applying herbicide to designated plant life.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
  
- B. Product Data: Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

1.4 QUALITY ASSURANCE

- A. Conform to applicable code for environmental requirements, disposal of debris.
  
- B. Perform Work in accordance with State of Michigan Department of Transportation standard specification for construction.
  
- C. Coordinate clearing work with utility companies.

PART 2 PRODUCTS

- A. NOT USED

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified.
- C. Identify waste area for placing removed materials.

### 3.2 PREPARATION

- A. Call Miss Dig (Local Utility Line) Information service at 1-800-482-7171 not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.

### 3.3 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping as specified in Section 01 50 00 - Temporary Facilities and Controls.
- C. Protect bench marks, survey stakes, survey control points, and existing structures from damage or displacement.
- D. All trees, shrubs, and bushes which are too large to be replaced in kind, shall be let undisturbed, with the utility being installed in a boring and/or tunneling operation, unless written consent from the property owner to remove the tree is obtained.
- E. The boring or tunneling operation shall be constructed in accordance with these specifications.
- F. The Contractor shall locate the boring or tunneling pit at a sufficient distance to insure no damage will occur to the tree.

### 3.4 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs indicated. Remove stumps, main root ball, surface rock, and as indicated on the plans.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

### 3.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Partially remove paving, curbs, and, sidewalk as indicated on Drawings. Neatly saw cut edges at right angle to surface.
- C. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.
- D. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- E. Trees, shrubs, and bushes which are removed and which are to be replaced shall be done so by an established nursery.
- F. Trees, shrubs, and bushes to be removed shall be done by falling the tree in sections, beginning from the top down and removing the stump and debris from the site.
- G. The property owner, at his option, may elect to claim the usable timber.
- H. If so, the Contractor shall be responsible for cutting the tree into manageable lengths and stockpiling same along the line of the work.
- I. If the property owner does not want the timber, it shall become the property of the Contractor.
- J. The cost of removing trees, brush, and bushes and the cutting of timber and removing debris from the site shall be included in the unit price for cleanup of the project.
- K. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- L. Do not burn or bury materials on site. Leave site in clean condition.

### 3.6 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site approved by the Engineer to depth not exceeding 8 feet and protect from erosion.

END OF SECTION

SECTION 31 22 13  
ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Excavating topsoil.
  - 2. Excavating subsoil.
  - 3. Cutting, grading, filling, rough contouring, and compacting the site for site structures.
  
- B. Related Sections:
  - 1. Section 31 05 13 - Soils for Earthwork: Soils for fill.
  - 2. Section 31 05 16 - Aggregates for Earthwork: Aggregates for fill.
  - 3. Section 31 10 00 - Site Clearing: Excavating topsoil.
  - 4. Section 31 23 23 - Fill: General building area backfilling.
  - 5. Section 32 91 19 - Landscape Grading: Finish grading with topsoil to contours.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Topsoil Fill Type S4:
  - 1. Basis of Measurement: Included in the lump sum bid for cleanup.
  - 2. Basis of Payment: Includes all associated labor, materials, equipment, excavation, fill for landscape grading and grading necessary to obtain the required contours and replacement of necessary fences, trees, shrubs, guard rail, mail boxes, and other landscaping necessary to return work area to preconstruction conditions.
  
- B. Subsoil Fill Type S2:
  - 1. Basis of Measurement: Included in the unit price bid for utility installation.
  - 2. Basis of Payment: Includes all associated labor, materials and equipment, fill, excavation, grading required for rough grading to provide the required contours and/or return the disturbed areas back to existing conditions.
  
- C. Structural Fill Type A2:
  - 1. Basis of Measurement: Included in the unit price bid for utility installation.
  - 2. Basis of Payment: Includes all associated labor, materials and equipment, excavation, fill, and grading required for rough grading to provide the required contours and/or return the disturbed areas back to existing conditions.
  
- D. Fine Aggregate Type A3 Class II:
  - 1. Basis of Measurement: Included in the unit price bid for utility installation.
  - 2. Basis of Payment: Includes all associated labor, materials and equipment, excavation, fill, and grading required for rough grading to provide the required contours and/or return the disturbed areas back to existing conditions.

### 1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
  - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3  - 3. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
  - 4. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3  - 5. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
  - 6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).</sup></sup>

### 1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Michigan Department of Transportation 2012 standard specifications for construction.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Topsoil: Type S4 as specified in Section 31 05 13.
- B. Subsoil Fill: Type S2 as specified in Section 31 05 13.
- C. Structural Fill: Type A2 as specified in Section 31 05 16.
- D. Granular Fill: Type A3 as specified in Section 31 05 16.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify site conditions under provisions of Section 01 30 00.
- C. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.
- D. Verify fill materials are acceptable.

### 3.2 PREPARATION

- A. Call Miss Dig at 811 not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove and relocate utilities.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### 3.3 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material in continuous layers and compact in accordance with schedule at end of this section.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Repair or replace items indicated to remain damaged by excavation or filling.

- G. The Owner may have a use for the surplus excess excavated material. If they do it shall be their property and the Contractor's responsibility to transport said material to the Owner's stockyard. All cost associated with transporting, hauling, and loading said material shall be included in other pay items of this project.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

### 3.5 SPOIL LEVELING

- A. As indicated on Drawings, or as directed by Engineer.
- B. Contractor shall be responsible for loading, hauling and spreading of all excess excavated material generated from this project.
- C. Place no excavated materials on roads without written permission of the authorities having jurisdiction of said road.
- D. Remove excavation in areas adjacent to yards where there is not suitable place to deposit spoils and dispose of as indicated on the drawings or off site as directed by the Engineer.
- E. Place no spoils in a watercourse or drain.

### 3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Test and analysis of fill material will be performed in accordance with MDOT Standards and with Section 01 40 00.
- C. Compaction testing will be performed in accordance with MDOT Standards and with Section 01 40 00.
- D. If testes indicate Work does not meet specified requirement, remove Work, replace and retest at no cost to the Owner.
- E. Frequency of Tests: As directed by the Engineer.

### 3.7 SCHEDULES

- A. Structural Fill:
  - 1. Fill Type A2: To subgrade elevation.
  - 2. Compact uniformly to minimum 98 percent of maximum density.



- B. Subsoil Fill:
  - 1. Fill Type A3 within the 1 on 1 influence of the road: To subgrade elevation.
  - 2. Fill Type S2 within the green belt outside the road influence.
  - 3. Compact uniformly to minimum 95 percent of maximum density.
  
- C. Topsoil Fill:
  - 1. Fill Type S3: Proposed elevation, 4 inches thick.
  - 2. Compact uniformly to minimum 95 percent of maximum density.

END OF SECTION

SECTION 31 23 16  
EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil densification.
2. Excavating for paving, roads, and parking areas.
3. Excavating for slabs-on-grade.
4. Excavating for structures.

B. Related Sections:

1. Section 31 05 13 - Soils for Earthwork: Stockpiling excavated materials.
2. Section 31 05 16 - Aggregates for Earthwork: Stockpiling excavated materials.
3. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
4. Section 31 23 17 - Trenching: Excavating for utility trenches.
5. Section 31 23 18 - Rock Removal: Removal of rock during excavating.
6. Section 31 23 23 - Fill.
7. Section 33 11 16 - Site Water Utility Distribution Piping.
8. Section 33 05 13 - Public Manholes and Structures.
9. Section 31 25 00 - Slope protection and erosion control.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Excavating Soil Materials:

1. Basis of Measurement: Included in the unit price bid for utility installation.
2. Basis of Payment: Includes all excavating, fill, labor, material, and equipment to required elevations, loading and removing excess from site. Over Excavating: Payment will not be made for over excavated work nor for replacement materials.

1.3 REFERENCES

- A. MISS DIG System, Inc.
- B. Act No. 174, Public Acts of 2013, latest revision.
- C. Special provisions made by local utility having jurisdiction.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

- C. Shop Drawings: Indicate soil densification grid for each size and configuration footing requiring soils densification.

## 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Michigan Department of Transportation standard specifications for construction.

## PART 2 PRODUCTS

Not Used.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Call MISS DIG at 811 not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company when specified to remove and relocate utilities.
- D. Identify known underground, above ground, and aerial utilities, stake, and flag locations.
- E. Protect above and below ground utilities indicated to remain from damage.
- F. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.
- G. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- H. Protect grade and slope stakes.

### 3.2 OPEN CHANNEL RELOCATION AND RESTORATION

- A. Clear site in accordance with Section 31 10 00 – Site Clearing.
- B. Excavation drain to dimensions and cross sections specified on drawings.
- C. Contractor shall check flow line elevations every 100 ft. (grade stakes will be provided by Engineer). Over excavation of 0.3 ft or greater will be filled with Type A1 – 6A compacted crushed limestone to the proposed flow line as incidental cost to the Contractor.
- D. Contractor shall remove all sediment from existing culverts to remain.

- E. When drain parallels a road, all excavation will be on field side slope unless stated on drawing or required by Engineer.
- F. Underpin adjacent structures which may be damaged by excavation work, including utilities and pipe chases.
- G. Machine slope banks to required slopes.
- H. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- I. Correct unauthorized excavation at no extra cost to Owner.
- J. Seed excavated areas daily in accordance with Section 32 92 19 – Seeding.
- K. Repair and replace field tile outlets as directed by Engineer.
- L. Match existing side slopes in reaches identified channel cleanout.
- M. Excess spoils on road sides and lawn areas are to be hauled away.
- N. When excavating one side slope of drain. The opposite ditch bank shall be cleared in accordance with Section 31 10 00 – Site Clearing. Grass vegetation should not be removed on opposite side slopes.

### 3.3 SPOIL LEVELING

- A. Seed spoils in accordance with Section 32 92 19 – Seeding.
- B. Place soil erosion and sedimentation control measures per SESC plan.
- C. Spoils placed on tillable land shall be spread evenly to allow for tilling.
- D. Spoils in wooded areas shall be stockpiled as shown on plans.
- E. Spoils are to be kept a minimum 3 feet from excavation area.
- F. No excavated materials shall be placed on roads without written permission of the authorities having jurisdiction of said road.
- G. Spoils excavated in areas adjacent to residential or lawn areas are to be removed from the area unless directed by the Engineer, shown on plans, or Contractor receives written permission from Landowner to level in area.
- H. No spoils are to be placed in any watercourse or drain.
- I. Side grade outs for watercourse and ditches shall be done at the time of open drain excavation or channel cleanout.

- J. Non-combustible items (i.e. roots and stumps), brush, or debris shall not be mixed with leveled spoil material.
- K. Shape leveled spoils to prevent the ponding of water behind spoil pile.
- L. Level spoils on the same side of the drain which excavation occurs. If excavation occurs from both sides of drain then made even spoil piles on both sides of drain unless otherwise directed by the Engineer.
- M. In agricultural areas, root rake and hand pick sticks and rocks so that foreign debris 1' in length and/or 6" in diameter is disposed of.

### 3.4 ROAD SHOULDER CONSTRUCTION

- A. Construct road shoulder and construct 2 horizontal to 1 vertical side slope to drain and valley shaped ditches.
- B. Prior to filling for shoulder construction, remove existing sediment, top soil, and vegetation from area to be filled.
- C. Fill and compact native material for road shoulder. Fill material shall be placed in 12"-24" lifts. Contractor will be responsible for the construction of stable side slopes.
- D. Fill materials must be dry and must be approved by Engineer. Fill materials will be native excavated material.

### 3.5 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Excavate subsoil to accommodate building foundations, paving and site structures, construction operations, and utility trenches.
- C. Slope banks with machine to angle of repose or less until shored.
- D. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- E. Trim excavation. Remove loose matter.
- F. Remove lumped subsoil, boulders, and rock up to 0.5 cu ft measured by volume. Remove larger material as specified in Section 31 23 18.
- G. Notify Engineer of unexpected subsurface conditions.
- H. Correct areas over excavated with structural fill type A2 as directed by Engineer.
- I. Remove excess and unsuitable material from site.

### 3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Request visual inspection of bearing surfaces by Engineer before installing subsequent work.

### 3.7 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

### 3.8 DUST CONTROL

- A. The Contractor shall implement measures to minimize dust, especially near residents, upon the Engineers request.

END OF SECTION

## SECTION 31 23 23

### FILL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fill under paving.
  - 2. Fill for raising manhole castings to grade.
  - 3. Fill under concrete slabs.
- B. Related Sections:
  - 1. Section 32 12 16 – Asphalt Paving
  - 2. Section 32 91 19 - Landscape Grading.
  - 3. Section 33 01 30.86 – Manhole Rim Adjustment

##### 1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Fill Type Sand Subbase:
  - 1. Basis of Measurement: Included in the lump sum price bid for rehabilitation of manhole chimney in pavement.
  - 2. Basis of Payment: Includes supplying fill materials, stockpiling, scarifying substrate surface, placing where required, and compacting.
- B. Structural Fill Type Aggregate Base Layer:
  - 1. Basis of Measurement: Included in the lump sum bid for rehabilitation of manhole chimney in pavement.
  - 2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.
- C. Concrete Fill:
  - 1. Basis of Measurement: Included in the lump sum price bid for rehabilitation of manhole chimney in pavement.
  - 2. Basis of Payment: Includes supplying fill material, forming, mixing and placing where required, and curing.

##### 1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).

2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

#### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- C. Materials Source: Submit name of imported fill materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed Michigan Department of Transportation construction standards.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Michigan Department of Transportation construction standards.
- B. Maintain one copy of each document on site.

### PART 2 - PRODUCTS

#### 2.1 FILL MATERIALS

- A. Structural Fill: Type A1 as specified in Section 31 05 16.
- B. Granular Fill: Type A2 as specified in Section 31 05 16.
- C. Concrete: Structural concrete as specified in Section 03 30 00 with compressive strength of 3500 psi.
- D. Soil Fill: Type S2 as specified in Section 31 05 13.
- E. Landscape Fill: Type S1 as specified in Section 31 05 13.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

### 3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

### 3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place material in continuous layers as follows:
  - 1. Structural Fill: Maximum 6 inches compacted depth.
  - 2. Granular Fill: Maximum 18 inches compacted depth.
- D. Employ placement method that does not disturb or damage other work.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Make gradual grade changes. Blend slope into level areas.
- G. Remove surplus backfill materials from site.
- H. Leave fill material stockpile areas free of excess fill materials.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.

### 3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform laboratory material tests in accordance with ASTM D1557.
- C. Perform in place compaction tests in accordance with the following:
  - 1. Density Tests: ASTM D2922.
  - 2. Moisture Tests: ASTM D3017.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

### 3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

### 3.7 SCHEDULE

- A. Fill Under Grass Areas:
  - 1. Fill Type S3 to 6 inches below finish grade.
- B. Fill Under Landscaped Areas:
  - 1. Fill Type S3 to 6 inches below finish grade.

END OF SECTION

## SECTION 31 32 21

### FILTER FABRIC

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Filter Fabric for Groundwater Infiltration Applications.
  - 2. Filter Fabric for Plain Riprap Applications.
  - 3. Filter Fabric for Heavy Riprap Applications.
- B. Related Sections:
  - 1. Section 31 22 13 – Rough Grading
  - 2. Section 31 35 21 – Slope Protection and Erosion Control

##### 1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Filter Fabric:
  - 1. Basis of Measurement: Included in unit price for plain riprap, grade and bank protection, plain riprap spillway, field tile outlets, surface outlet tubes, drain crossings, plain riprap splash pad, check dams, sedimentation basins, or other Work item being accomplished, whichever applies.
  - 2. Basis of Payment: Includes material, labor, and equipment for installation according to plans, specifications, and manufacturer's instructions.

##### 1.3 REFERENCES

- A. ASTM D-4632 - Test method for Tensile Strength and Elongation
- B. ASTM D-3786 - Test method for Mullen Burst.
- C. ASTM D-4533 - Test method for Trapezoidal Tear Strength.
- D. ASTM D-3787 - Test method for Puncture Strength.
- E. ASTM D-4751 - Test method for Apparent Opening Size.
- F. ASTM D-4491 - Test method for Coefficient of Permeability

##### 1.4 COORDINATION

- A. Section 01 30 00 – Administrative Requirements specifies requirements for coordination.
- B. Coordinate Work of this Section with Section 31 37 00 – Riprap.

## 1.5 SUBMITTALS

- A. Submit shop drawings and product data for all items to be installed and/or constructed within this Section.
- B. Submit manufacturer's instructions for all product data.
- C. Submit manufacturer's certificate, which shall show actual test values obtained for the physical properties as tested for compliance with the specifications, for all product data.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Mechanically bonded, non-woven, long-chain polymeric fibers or yarns. The edges of the fabric shall be finished to prevent the outer fiber from pulling away from the fabric.
  - 1. Filter fabric for groundwater infiltration applications (french drains, trench drains, pipe joint wrap, etc.) and embankment filter fabric is to have, at minimum, the following properties:

Tensile Strength	100 lbs
Tensile Elongation (max)	100 %
Mullen Burst	210 psi
Trapezoidal Tear Strength	40 lbs
Puncture Strength	65 lbs
Apparent Opening Size (max)	70 sieve
Flow Rate	140 gal/min/ft <sup>2</sup>

- 2. Filter fabric for plain riprap applications (riprap, riprap spillways, etc.) and concrete box culvert joints are to have, at minimum, the following properties:

Tensile Strength	155 lbs
Tensile Elongation (max)	100 %
Mullen Burst	315 psi
Trapezoidal Tear Strength	65 lbs
Puncture Strength	95 lbs
Apparent Opening Size (max)	70 sieve
Flow Rate	110 gal/min/ft

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for installation examination.
- B. Verify the correct fabric is specified for the specific use.

- C. At the time of installation, the filter fabric may be rejected at the discretion of the Engineer if it has been removed from its protective cover for over 72 hours or has defects, tears, punctures, flow deterioration, or damage incurred during manufacture, transportation or storage.
- D. No torn, punctured, or otherwise damaged fabric shall be installed.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for installation preparation.
- B. Remove large stones or other debris, which could damage the filter fabric.
- C. Adjacent Surfaces: Protect adjacent surfaces.

### 3.3 STORAGE

- A. During all periods of shipment and storage, the filter fabric shall be protected from abrasion, direct sunlight, ultraviolet rays, and temperatures greater than 140 degrees Fahrenheit (or as directed by the manufacturer). To the extent possible, the fabric shall be maintained wrapped in its protective covering.

### 3.4 INSTALLATION

- A. All joints/overlaps in material shall be a minimum of 2 feet.
- B. Any damaged material shall be repaired by placing a piece of fabric that is sufficiently large to cover the damaged area plus 2 feet of adjacent undamaged geotextile in all directions.
- C. Finish according to specific use requirements.
- D. Edges of filter fabric shall be toed in 12 inches unless specified otherwise. Work will not pass inspection if filter fabric is not "toed in."

### 3.5 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for protecting finished Work.
- B. Do not permit Traffic over unprotected surface.
- C. Take care placing material over filter fabric so as not to damage the material.

END OF SECTION

## SECTION 31 32 21

### SLOPE PROTECTION AND EROSION CONTROL

#### 1. PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Live Wattles (soft shore engineering).
- B. Live Stakes (soft shore engineering).
- C. Rip-rap – see Section 31 37 00.

##### 1.2 RELATED SECTIONS

- A. Section 01500 – Construction Facilities and Temporary Controls.
- B. Section 02210 – Site Clearing.
- C. Section 02211 - Rough Grading.
- D. Section 02222 - Excavation.
- E. Section 02223 - Backfilling.
- F. Section 02274 – Soil Erosion and Sedimentation Control.
- G. Section 02279 - Filter Fabric.
- H. Section 02923 - Landscape Grading.
- I. Section 02936 – Seeding.

##### 1.3 REFERENCES

- A. ASTM D-4595 - Test Method for geo-grid tensile strength.
- B. Part 91 of Act No. 451, of 1994, relative to Soil Erosion and Sedimentation Control Act.
- C. National Crushed Stone Association (N.C.S.A.).
- D. Michigan Department of Transportation: Standard Specifications for Construction.
- E. ANSI Z60.1 - Nursery Stock; current edition
- F. American Standard for Nursery Stock; current edition
- G. Hortus III - current edition. Bailey Horatium, Cornell University

#### 1.4 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Soft Shore Engineering:
  - 1. Basis of Measurement: At the unit price bid per linear foot as stated in the proposal.
  - 2. Basis of Payment: Includes all labor, materials and equipment to provide bank stabilization methods as described in the proposal including all excavation, site preparation, plant material, backfilling, soil, mulch, seeding, stone, filter fabric, stakes, erosion control measures required to stabilize the planting slopes and other required accessories for a complete project.

#### 1.5 QUALITY ASSURANCE

- A. Acceptability of plants will be determined by the Engineer.
- B. Plants must be clearly labeled according to species.

#### 1.6 SUBMITTALS

- A. Submit under provisions of Section 01300 - Submittals.
- B. Submit shop drawings and product data for all items to be installed and/or constructed within this Section.

#### 1.7 REGULATORY REQUIREMENTS

- A. Plant Materials: Certified by the State Department of Agriculture as described by ANSI- Z60.1 to be free of disease or hazardous insects.
- B. Comply with state agencies for plant material certification and inspection.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.
- B. Live Wattles:
  - 1. Plant material shall be harvested just before shipment to the site or harvested no earlier than two months before planting and put in refrigerated storage at 40°F to 50°F.
  - 2. When shipped, plants shall be transported in enclosed or covered vehicles and scheduled to arrive on site within 24 hours.
  - 3. The plants shall be bundled and packed to prevent damage to the bark, limbs or root systems.
  - 4. All bare root plants shall be treated with a root gel to prevent drying.
  - 5. Furnish standard products in manufacturer's standard containers bearing original labels legibly showing quantity, analysis, genus/species and name of manufacturer/grower.

6. Keep plants moist at all times and protected from the wind, sun, drying out or other damage. Cuttings shall be stored to protect them from drying out by keeping them in a cool place and damp. Cuttings or unrooted stock not planted within two days after arrival on the site shall be discarded unless refrigerated at 40°F to 50°F. Discarded materials shall be replaced from commercial sources at the contractor's expense.
7. The Engineer may reject injured plants.

## 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Live Wattles and Live Stakes: All planting of woody vegetation shall be accomplished during the dormant season, between October 1<sup>st</sup> and May 15<sup>th</sup>.

## 1.10 COORDINATION

- A. Coordinate work under provisions of Section 01039.
- B. Perform Planting as other construction activities allow.
- C. Do not install plant materials prior to acceptance of final grades.

## 2. PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Live Wattles.
  1. Bundles shall be prepared from live, shrubby material. Wattle bundles may vary in length. Diameter of branches used in the wattles shall not be more than 1½ inches. Stems shall be placed in the same direction and overlapped to create a shingled effect. When compressed firmly and tied, each bundle shall be 4 to 8 inches in diameter.
  2. Wattles shall be tied in a manner that gathers all branches on a 12 to 24 inch center with a minimum of two wraps of natural undyed bailing twine by non-slipping knot.
  3. Plant materials shall be live, viable woody vegetation free of insects and diseases. The harvested plant materials shall be harvested from existing stands of living woody vegetation, or from commercial sources. The harvested plant materials shall be one of the following listed species and determined suitable by the Engineer:
    - a. *Alnus rugosa*, Speckled Alder
    - b. *Cornus sericea*, Redosier Dogwood
    - c. *Cornus amomum*, Silky Dogwood
    - d. *Cephalanthus occidentalis*, Buttonbush
    - e. *Physocarpus opulifolius*, Ninebark
    - f. *Salix purpurea*, Purpleosier Willow
    - g. *Salix cottetii*, Dwarf Willow
    - h. *Salix interior*, Sandbar Willow
    - i. *Salix caroliniana*, Ward's Willow
    - j. *Salix rigida*, Heartleaf Willow
    - k. *Salix sericea*, Silky Willow



- l. Sambucus canadensis, American Elderberry
- m. Viburnum acerifolium, Mapleleaf Viburnum
- n. Viburnum cassinoides, Wild raisin
- o. Viburnum lentago, Nannyberry
- p. Viburnum prunifolium, Black Haw
- q. Viburnum recognitum, Smooth Viburnum

B. Live Stakes.

- 1. Live Stakes shall be living, woody plant cuttings with side branches removed and the bark intact.
- 2. They shall be prepared from 1/2 inch to 2 inch diameter stock and cut into lengths that will reach sustainable soil moisture when installed, generally 2 to 5 feet.
- 3. The basal or butt ends shall be cleanly cut at an angle to facilitate easy insertion into the soil. The top shall be cut square or blunt.
- 4. Species shall consist of one of the listed species in Section 2.1.A.2 of this specification.

C. Dead Stout Stakes - shall be cut to a minimum length of 24 inches from untreated 2 x 4 inch lumber. Each length shall be cut diagonally across the 4 inch face, to produce two dead stout stakes. The diagonal cut shall begin and end 1/8 to 1/4 inch from the edge of the piece so the finished stake has a 1/8 to 1/4 inch tip. Only sound lumber shall be used.

D. Cobblestone - Sound, tough, durable rock or crushed limestone free from structural defects. Sound pieces of concrete may be used in place of cobblestone when approved by the Engineer. Material to be uniform in size and not less than 6 inches in the least dimension. MDOT 8.19.01.

E. Plain Rip-rap - Sound, tough, durable rock or crushed limestone free from structural defects. Sound pieces of concrete may be used in place of plain rip-rap when approved by the Engineer. Material to be uniform in size and not less than 8 inches in the least dimension. MDOT 8.19.02.

F. Heavy Rip-rap - Sound, tough, durable rock or crushed limestone free from structural defects. Material to be uniform in size and not less than 16 inches in the least dimension. MDOT 8.19.03.

G. Filter Fabric - In accordance with Section 2279 - Filter Fabric.

H. Geo-Grid Netting - For reinforced grass spillways shall meet or exceed the following requirements as per ASTM D-4595.

Tensile Strength	2,000 lbs/ft
Tensile Modules at 5% Strain	14,900 lbs/ft
Maximum Aperture Area	1 sq. inch

I. Metal Pins - Shall be those specified by the manufacturer to use with geo-grid netting and as approved by the Engineer.

J. Straw Mulch - 2" thickness of oat or wheat straw or an erosion control blanket that uses straw or straw/coconut mulch at the rate of 0.5 lbs. per sq. yd.

### 3. PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Implement temporary controls under provisions of Section 01500 - Temporary Controls.

#### 3.2 EXECUTION

##### A. Live Wattles.

1. Installation of plant materials should begin concurrently with the earth moving operations and should be completed no later than 10 days after the slope has been prepared.
2. When the planting is delayed beyond 10 days, the slope shall be protected from erosion by mulching with straw at the rate of 2 tons per acres or installing erosion control blankets.
3. Wattle trenches shall be spaced as shown on the drawings. Trenches shall be dug on the horizontal contour to a depth of  $\frac{3}{4}$  the diameter of the bundle.
4. Beginning at the bottom of the slope and proceeding upward, the live wattle bundle shall be placed in the prepared trench with ends of the bundles overlapping at least 12 inches.
5. Dead stout stakes shall be driven directly through the wattle bundles every 3 feet along the length or as needed to secure the wattle in the trench. Where bundles overlap, an additional stake shall be used at the midpoint of the overlap.
6. The wattle bundle shall be covered immediately with soil and tamped. Installers shall walk on the wattle as work progresses to further work soil into the bundles. It is important to achieve the maximum plant material to soil contact to insure successful root emergence.
7. Ten to twenty percent of the bundle shall be left exposed when construction is completed.

##### B. Live Stakes.

1. Live stakes shall be tamped into the ground beneath the live wattle bundle, in between the previously placed dead stakes.
2. Live stakes shall be installed in the configuration, spacing, and areas shown on the drawings.
3. The cuttings shall be tamped into the ground at right angles to the slope to a minimum depth of 18 inches for a firm hold. Where soils are soft and 24 inch stakes are not solid (i.e., if they can be moved by hand) 36 inch stakes shall be used.
4. Where soils are so compacted or frozen that 24 inch stakes cannot be tamped into the ground without splitting, pilot holes shall be drilled using an auger or reinforcing rod. Pilot holes shall be narrower in diameter than the live stakes.

END OF SECTION



SECTION 32 31 13  
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Fence framework, fabric, and accessories.
  - 2. Excavation for post bases.
  - 3. Concrete foundation for posts and center drop for gates.
  - 4. Manual gates and related hardware.
  - 5. Privacy slats.
  
- B. Related Sections:
  - 1. Section 33 79 00 - Site Grounding.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. 4' Tall Chain Link Fence:
  - 1. Basis of Measurement: Included in the per foot bid price as stated in the proposal.
  - 2. Basis of Payment: Includes posts, rails, tension wire, fabric, wind screen (for 4' fence) accessories and attachments.
  
- B. Post Footings and Perimeter Edging:
  - 1. Basis of Measurement: Included in the bid price for fence as stated in the proposal.
  - 2. Basis of Payment: Includes excavation, concrete placed, finishing.
  
- C. Gates:
  - 1. Basis of Measurement: Included in the bid price for fence as stated in the proposal.
  - 2. Basis of Payment: Includes frame posts, fabric, accessories, hardware.

1.3 REFERENCES

- A. ASTM International:
  - 1. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
  - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
  - 5. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
  - 6. ASTM A817 - Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire.
  - 7. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
  - 8. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

9. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
10. ASTM F552 - Standard Terminology relating to Chain Link Fencing.
11. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
12. ASTM F626 - Standard Specification for Fence Fittings.
13. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
14. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
15. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
16. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
17. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
18. ASTM F1183 - Standard Specification for Aluminum Alloy Chain Link Fence Fabric.
19. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.
20. ASTM F1345 - Standard Specification for Zinc - 5% Aluminum -Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric.

B. Chain Link Fence Manufacturers Institute:

1. CLFMI - Product Manual.

#### 1.4 SYSTEM DESCRIPTION

- A. Fence Height: as indicated on Drawings.
- B. Line Post Spacing: At intervals not exceeding 5 feet.
- C. Fence Post and Rail Strength: Conform to ASTM F1043 Heavy Industrial Fence quality.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.
- D. Manufacturer's Installation Instructions: Submit installation requirements, post foundation anchor bolt templates.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.
- C. Operation and Maintenance Data: Procedures for submittals.

## 1.7 QUALITY ASSURANCE

- A. Supply material in accordance with CLFMI - Product Manual.
- B. Perform installation in accordance with ASTM F567.
- C. Perform Work in accordance with manufacturer's instructions and CLFMI – Product Manual.
- D. Maintain one copy of each document on site.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

## 1.9 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
- C. Identify each package with manufacturer's name.
- D. Store fence fabric and accessories in secure and dry place.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers:
  - 1. Allied Fence Mfg., Co Product: Chainlink Fence.
  - 2. Anchor Fence Co. Product: Chainlink Fence.
  - 3. Substitutions: Section 01 60 00 - Product Requirements.
  - 4. Approved equal.

### 2.2 MATERIALS AND COMPONENTS

- A. Materials and Components: Conform to CLFMI Product Manual.
- B. Fabric Size: CLFMI Heavy Industrial service.
- C. Intermediate Posts: Type I round.
- D. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.
- E. Concrete: Normal Portland Cement, 2,500 psi strength at 28 days.

## 2.3 COMPONENTS

- A. Line Posts: 2.5 inch diameter.
- B. Corner and Terminal Posts: 3.0 inch.
- C. Gate Posts: 3.0 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Gate Frame: 1.66 inch diameter for welded fabrication.
- F. Fabric: 1 3/4 inch diamond mesh interwoven wire, vinyl coated, 9 gauge thick, top selvage knuckle end closed, bottom selvage knuckle end closed.
- G. Tension Wire: 6 gauge thick steel, single strand, marcelled, spiraled or crimped, aluminum-coated tension wire conforming to ASTM A824.
- H. Tension Band: 0.078 inch thick by 3/4 inch wide steel.
- I. Tension Strap: 3/16 inch by 3/4 inch steel.
- J. Tie Wire: Aluminum alloy steel wire.

## 2.4 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.
- C. Gate Hardware: Center gate stop and drop rod Mechanical keepers; two 180 degree gate hinges for each leaf and hardware for padlock.

## 2.5 GATES

- A. General:
  - 1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
  - 2. Factory assemble gates.
  - 3. Design gates for operation by one person.
- B. Swing Gates:
  - 1. Fabricate gates to permit 180 degree swing.
  - 2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.
- C. Sliding Gates:
  - 1. Framing and Posts: ASTM F1184, Class 2 for internal rollers.
  - 2. Rollers for overhead and cantilever sliding gates: Bearing type. Furnish non-sealed bearings with grease fitting for periodic maintenance.
  - 3. Secure rollers to post or frame without welding.

## 2.6 FINISHES

- A. Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 1.8 oz/sq ft coating.
- B. Hardware: Galvanized to ASTM A153/A153M, 1.8 oz/sq ft coating.
- C. Accessories: Same finish as framing.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with manufacturer's instructions.
- B. Set intermediate, terminal, gate, and corner posts plumb, in concrete footings with top of footing flush with finish grade. Slope top of concrete for water runoff.
- C. Line Post Footing Depth Below Finish Grade: 3.5 feet.
- D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: 3.5 feet.
- E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
- F. Install top rail through line post tops and splice with 6 inch long rail sleeves.
- G. Install center and bottom brace rail on corner gate leaves.
- H. Place fabric on outside of posts and rails.
- I. Do not stretch fabric until concrete foundation has cured seven days.
- J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- K. Position bottom of fabric 1/2 inches above finished grade.
- L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- N. Install bottom tension wire stretched taut between terminal posts.
- O. Support gates from gate posts. Do not attach hinged side of gate from building wall.
- P. Install gate with fabric to match fence. Install three hinges on each gate leaf, latch, catches, drop bolt.



- Q. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- R. Connect to existing fence at new terminal post.
- S. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.
- T. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.

### 3.2 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch.
- C. Maximum Offset From Indicated Position: 1 inch.
- D. Minimum distance from property line: 6 inches.

END OF SECTION

## SECTION 32 91 19

### LANDSCAPE GRADING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Final grade topsoil for finish landscaping.
- B. Related Sections:
  - 1. Section 31 23 17 - Trenching: Backfilling trenches.
  - 2. Section 32 92 19 - Seeding and Soil Supplements: Finish ground cover.
  - 3. Section 32 93 00 - Plants: Topsoil fill for trees, plants and ground cover.

##### 1.2 MEASUREMENT AND PAYMENT

- A. Landscape Grading:
  - 1. Basis of Measurement: Included in the lump sum price bid for Landscaping/Site Restoration and Cleanup as stated in the proposal.
  - 2. Basis of Payment: Includes all labor, material and equipment required for landscape grading necessary for this project, including excavation, fill and grading necessary to obtain the required contours and replacement of necessary fences, trees, shrubs, guardrail, and other items necessary

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

##### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Michigan Department of Transportation Standards.

#### PART 2 PRODUCTS

##### 2.1 MATERIAL

- A. Topsoil: As specified in Section 32 91 13.

#### PART 3 EXECUTION

##### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

- B. Verify building and trench backfilling have been inspected.
- C. Verify substrate base has been contoured and compacted.

### 3.2 PREPARATION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

### 3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove contaminated subsoil.
- C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

### 3.4 PLACING TOPSOIL

- A. Place topsoil in areas where seeding, sodding or planting, is required to minimum depth of 4 inches. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to plant material, building, utilities and curbs to prevent damage.
- E. Roll placed topsoil.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

### 3.5 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top of Topsoil: Plus or minus 1/2 inch.

### 3.6 PROTECTION OF INSTALLED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Prohibit construction traffic over topsoil.

### 3.7 SCHEDULES

- A. Compacted topsoil thicknesses: Minimum four inches (4") thickness.

END OF SECTION

## SECTION 32 92 19

### SEEDING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fertilizing.
  - 2. Seeding.
  - 3. Hydroseeding.
  - 4. Mulching.
  - 5. Maintenance.
  - 6. Turfgrass Sod

##### 1.2 Related Sections:

- A. Sections as part of the new HVAC equipment pad on the west end of the building and the landscaping for this area.

##### 1.3 REFERENCES

- A. ASTM International:
  - 1. ASTM C602 - Standard Specification for Agricultural Liming Materials.
- B. FS 0-F-241 – Fertilizers, Mixed, Commercial.

##### 1.4 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

##### 1.5 PROTECTION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect existing structures, fences, roads, sidewalks, paving, mailboxes curbs, etc.

##### 1.6 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Submit product data for all items to be installed and/or constructed within this Section.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

## 1.7 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

## 1.8 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.
- B. The Contractor shall make arrangements to obtain seed materials with nurseries a maximum of 30 days after he/she is awarded the contract and provide a list of suppliers and seed mix to the Engineer for approval.

## 1.9 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

## 1.10 QUALIFICATIONS

- A. Seed Supplier: Company specializing in manufacturing, growing and cultivating the products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.
- C. Maintenance Services: Shall be paid by the Contractor for up to one (1) year to guarantee establishment of growth.

## 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Deliver grass seed mixture in sealed containers or RTF sod on pallets. Seed in damaged packaging is not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

## 1.12 MAINTENANCE SERVICE

- A. Section 017000 - Execution and Closeout Requirements: Requirements for maintenance service.
- B. Maintain seeded and sodded areas immediately after placement until grass is well established, exhibits a vigorous growing condition and is accepted by Owner. Guarantee replacement of dead material for one year from date of substantial completion.

- C. Contractor shall be responsible for maintaining adequate seedbed moisture until the sodbed is established.

### 1.13 WARRANTY AND REPLACEMENT

- A. Seeded areas must have a relatively uniform stand of grass with no bare spots over 6 inches square at the time of substantial completion. Reseed at the original rate. All areas failing to establish growth within ninety (90) days after germination or one growing season, whichever is longest, for any reason whatsoever, will be redone at the contractor's expense.

## PART 2 PRODUCTS

### 2.1 MATERIALS (Seeding)

- A. Furnish materials in accordance with Municipal, Federal and State Standards.
- B. Topsoil for seeding: Imported, friable loam; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4 percent and a maximum of 25 percent organic matter.
  - 1. Reused topsoil excavated from the site will be free of subsoil, roots, grass, excessive amount of weeds, stone and foreign matter.
- C. Grass Seed Mix:
  - 1. Survivor Mix:
    - 15% Kentucky Bluegrass (1 variety)
    - 15% Turf Type (1 elite variety) Perennial Ryegrass
    - 15% Chewings Fescue (1 elite variety)
    - 15% Creeping Red Fescue (1 variety)
    - 40% Turf Type Tall Fescue (1 elite variety)
- D. Fertilizer: FS O-F-241, type and grade recommended for grass, with 50% of the elements derived from organic sources and of proportion necessary to eliminate deficiencies of topsoil to the following proportions: 18% nitrogen, 24% phosphoric acid, 6% potassium.
  - 1. To be placed on landscape seeding.
- E. Mulch: Small grain straw mulch that is clean and weed free unless otherwise indicated.
  - 1. Hydroseeding Mulching Material: Conwed Verdoyl #2000.
  - 2. Mulch Blankets:
    - a. North American Green SC150BN, or approved equal, in areas with slopes 4 horizontal to 1 vertical and steeper as indicated on the plans or directed by the Engineer.
      - 1) Install all mulch blankets with 6 inch North American Green Eco Stakes, or approved equal. Stake according to manufacturer's recommendations as approved by the Engineer.
- F. Soil Binding Agent: Non-toxic, biodegradable materials that are environmentally safe. Applied at a rate of 1 lb per 1000 sq ft.
- G. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

- H. Lime: ASTM C602, Class T agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.

Herbicide: 25% Prometon, 4-bis, and 75% inert ingredients.

## 2.2 MATERIALS (Certified RTF Turfgrass Sod)

- A. Turfgrass Sod: Sod shall be RTF (U.S. Patent NO. 6,677,507) as produced by members of the RTF Turf Producers Association. Local grower must be licensed.
- B. Deliveries must have the authenticity of the sod with no exceptions. Thickness of the cut by machine shall be 0.60 inch plus or minus 0.25 inch. Measurement for thickness shall exclude top growth and thatch. Grass/sod to match patent no. "6,677,507" certificate #36788 with a verification code of "5shavb9g".
- C. Individual pieces of turfgrass sod shall be cut to the supplier's standard width and length. Broken pads and torn or uneven ends will not be acceptable.
- D. Standard size sections of turfgrass sod shall be strong enough that it can be picked up and handled without damage.
- E. Turfgrass sod shall not be harvested or transplanted when its moisture content (excessively dry or wet) may adversely affect its survival.
- F. Before harvesting, the turfgrass shall be mowed uniformly at a height of 1 to 2.5 inches.

## 2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Notify Engineer 72 hours prior to laying sod or, hydroseeding and fertilizing for approval to proceed.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

### 3.2 PREPARATION OF SUBSOIL

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil. Do not bury foreign material.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.



### 3.3 FERTILIZING

- A. Apply fertilizer at application rate 8 lbs per 1,000 square feet.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Do not apply fertilizer at same time or with same machine used to apply seed.
- D. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- E. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

### 3.4 SEEDING

- A. Apply seed at rate of 8 lbs per 1,000 square feet, evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting Season: May 1 to October 10 unless otherwise approved by the Engineer.
- D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.
- E. Roll seeded area with roller not exceeding 112 lbs/linear foot.
- F. Immediately following seeding and compacting, apply mulch to thickness of 1/8 inches. Maintain clear of shrubs and trees.
- G. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

### 3.5 HYDROSEEDING

- A. Apply seeded slurry for lawn with a hydraulic seeder at a rate of 8 lbs per 1000 sq ft evenly in two intersecting directions. Native seed will be seeded at the rate earlier specified in this section.
- B. Do not hydroseed area in excess of what which can be mulched on same day.
- C. Immediately following seeding, apply mulch at a rate of 50 lbs per 1000 sq ft. Maintain clear of shrubs and trees.
- D. Apply water with a fine spray immediately after each area has been mulched. Saturate to 3 inches of soil.

### 3.6 TURFGRASS SOD

- A. Turfgrass sod shall be harvested, delivered and installed/transplanted within a period of 24 hours, unless a suitable preservation method is approved prior to delivery. Turfgrass sod not transplanted within this period shall be inspected and approved by the inspecting officer or his representative prior to its installation.

- B. Turfgrass sod shall be delivered to the site specified in the contract and off-loaded using equipment furnished by the turfgrass sod supply contractor. Palletized or large-roll turfgrass sod shall be off-loaded at the locations designated for this purpose at the installation site.
- C. Acceptance will be given by the general contractor, owner or their agent upon satisfactory completion of each delivery to the area(s) as indicated on the drawings or as otherwise specified and after an RTF sod certificate is presented.
- D. Approved supplier: Huggett Sod Farm, Inc.  
4114 Marlette Road  
Marlette, MI 48453  
989-635-7482

### 3.7 SEED PROTECTION

- A. Cover seeded slopes where grade is 6 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- B. Lay fabric smoothly on surface, bury top end of each section in 6-inch-deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.
- C. Secure outside edges and overlaps at 36 inch intervals with stakes.
- D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

### 3.8 QUALITY CONTROL

- A. Notify Engineer 3 working days prior laying sod or seeding and fertilizing for approval to proceed.
- B. Seeding shall not be done during windy weather (above 25 mph) or when the ground is overly wet (saturated) or frozen.
- C. All areas that are partially completed to grade, will be prepare and seeded during the first available planting period and will not be allowed to sit idle for long periods of time without receiving the erosion control specified in the contract.
- D. Planting Season: April 1 to May 31, or September 1 to October 31. No Seeding shall be done before or after these dates with the Engineer's written approval.

### 3.9 MAINTENANCE

- A. Contractor shall guarantee a uniform grass growth over the entire project and shall reseed bare and thin areas until this is accomplished at no additional cost to the project.
- B. Immediately reseed areas showing bare spots.
- C. Repair any eroded areas and reseed immediately.
- D. Water to prevent grass and soil from drying out.

- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- G. Repair washouts or gullies.
- H. Monitor all seeded areas during site visits for any issues.
- I. Protect from traffic and erosion in newly seeded areas is the responsibility of the Contractor. Safety fences and/or silt fences with appropriate signage may be used at the Contractor's expense until the grasses are fully established.

END OF SECTION