



State of Michigan

**Department of Technology, Management and Budget
State Facilities Administration
Design and Construction Division**

**DCSPEC
Bidding and Contract Document
Minor Projects**

**File No. 511/23337.AGY
Funding Code 1340
Department of Military and Veterans Affairs
Renovate Armory
Detroit Light Guard Armory
Detroit, Michigan**

Bid Opening Date: July 12, 2023

BID SUMMARY
DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET

STATE FACILITIES ADMINISTRATION
 DESIGN AND CONSTRUCTION DIVISION
 3111 W. St. Joseph Street
 Lansing, Michigan 48917

Bids must be submitted electronically through the SIGMA VSS website at
<https://sigma.michigan.gov/webapp/PRDVSS2X1/AltSelfService>

FILE NUMBER 511/23337.AGY	FUNDING CODE 1340	DEPARTMENT/AGENCY Military and Veterans Affairs	
CONTRACT TIME(S) 365 Days	PROJECT NAME Renovate Armory	LOCATION Detroit Light Guard Armory 4400 E. 8 Mile Road Detroit, MI 48234	
BID OPENING DATE July 12, 2023 at 2:00 pm ET		FOR AN EXAMINATION OF THE SITE CONTACT: Doug Shilling (517) 599-6881	
SEE SECTION 00100 INSTRUCTIONS TO BIDDERS AND SECTION 00700 GENERAL CONDITIONS PROVIDED WITH THE BIDDING DOCUMENTS. BID: WE PROPOSE TO FURNISH, PERFORM AND COMPLETE THE ENTIRE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS IN CONSIDERATION OF THE BID PRICE (S) STATED BELOW.			
FIRM NAME AND COMPLETE ADDRESS		TELEPHONE NUMBER and E-MAIL ADDRESS	
<input type="checkbox"/> Qualified Disabled Veteran		SIGMA VENDOR NUMBER <small>(protected information required for processing payments)</small>	
BIDDER'S SIGNATURE AND TITLE	DATE	WITNESS' SIGNATURE	DATE

By signing this bid above, bidder certifies their enclosed Qualified Disabled Veteran and Michigan-Based Business Certifications.

BASE BID FROM BID SCHEDULE (Include specified Allowances):

_____ Dollars \$ _____	(use words)	(in figures)
Alternate 1: (Add/Subtract) _____ Dollars \$ _____	(use words)	(in figures)
Alternate 2: (Add/Subtract) _____ Dollars \$ _____	(use words)	(in figures)
Alternate 3: (Add/Subtract) _____ Dollars \$ _____	(use words)	(in figures)

A PERFORMANCE BOND AND A PAYMENT BOND ARE REQUIRED FOR ALL BIDS OVER \$50,000.00. EACH BID MUST BE ACCOMPANIED BY A FIVE (5) PERCENT BID GUARANTEE. BUILDERS RISK INSURANCE IS REQUIRED TO BE PROVIDED BY THE CONTRACTOR UNLESS OTHERWISE INDICATED IN THE BID DOCUMENTS.

BIDDERS ARE ALSO CAUTIONED TO FAMILIARIZE THEMSELVES WITH ALL OF THE OTHER CONDITIONS OF THE CONTRACT.

Project Scope of Work:

The work under this contract includes, but is not necessarily limited to providing all labor, equipment, and materials to; renovate armory and all related work, at the Detroit Light Guard Armory, in accordance with these specifications and accompanying drawings, DMVA Project No. 26A8023010.

The Bidder must figure its Base Bid on the specified, or Addendum-approved, materials and equipment **only**. No "or equal" or substitution proposals will be permitted after Bid opening, except as provided in the General Conditions.

Addenda: Bidder acknowledges receipt of Addenda: No. ___ dated: _____, No. ___ dated: _____ No. ___ dated: _____

FIRM NAME	TELEPHONE NUMBER and E-MAIL ADDRESS
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BID SCHEDULE

Base Bid Schedule - The Bidder will complete the Work and accept as full payment, for the Work items listed, the following Unit Prices and/or Item Bid Prices, as applicable:

Base Bid Item No.	Bid Quantity	Description	Unit Price	Item Bid Price
1	200 gal	Pump and remove the liquid from the coal pit (See drawing sheet A2), transport and dispose of the liquid in accordance with all State of Michigan liquid industrial byproduct regulations, federal and local regulations.		
		ALLOWANCE AMOUNT	\$150,000	\$150,000
TOTAL (This amount should equal the Base Bid amount on the Bid Summary Form)				\$

Base Bid (Sum of Item Bid Prices for all Base Bid Items):

_____ Dollars \$ _____
 (use words) (in figures)



DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET
State Facilities Administration
Design & Construction Division

Qualified Disabled Veteran (QDV) Business Representation

'Qualified Disabled Veteran,' means a business entity that is 51% or more owned by one or more veterans with a service-connected disability.

'Qualified Disabled,' means a business entity that is 51% or more owned by one or more with a service-connected disability.

The vendor represents that it IS _____, a qualified disabled veteran.

The contractor represents and warrants that the company meets the above (when checked) and has attached supporting documentation per the following:

Each bid requesting the Qualified Disabled Veterans (QDV) preference, in accordance with Public Act 22 of 2010, MCL 18.1241.3 shall include a DD214 Proof of Service and Discharge, a Veterans Administration rating decision letter, proof of disability (if the disability is not indicated on the DD214), and appropriate legal documents setting forth the 51% natural persons QDV ownership.

Fraudulent Certification as a Qualified Disabled Veteran may result in debarment under MCL 18.264.

Certification of a Michigan Based Business

(Information Required Prior to Contract Award for Application of State Reciprocity Provisions)

To qualify as a Michigan Based Business:

Vendor must have, during the 12 months immediately preceding this bid deadline:

or

If the business is newly established, for the period the business has been in existence, it has:

(Check all that apply):

- Filed a Michigan single business tax return showing a portion, or all the income tax base allocated or apportioned to the State of Michigan pursuant to the Michigan Single Business Tax Act, 1975 PA 228, MCL 208.1 – 208.145: or
- Filed a Michigan income tax return showing income generated in or attributed to the State of Michigan; or
- Withheld Michigan income tax from compensation paid to the bidder's owners and remitted the tax to the Department of Treasury; or

I certify that **I have personal knowledge** of such filing or withholding, that it was more than a nominal filing for the purpose of gaining the status of a Michigan business, and that it indicates a significant business presence in the state, considering the size of the business and the nature of its activities.

I authorize the Michigan Department of Treasury to verify that the business has or has not met the criteria for a Michigan business indicated above and to disclose the verifying information to the procuring agency.

Bidder shall also indicate one of the following:

- Bidder qualifies as a Michigan business (provide zip code: _____)
- Bidder does not qualify as a Michigan business (provide name of State: _____).
- Principal place of business is outside the State of Michigan, however service/commodity provided by a location within the State of Michigan (provide zip code: (_____)).

Fraudulent Certification as a Michigan business is prohibited by MCL 18.1268 § 268. A BUSINESS THAT PURPOSELY OR WILLFULLY SUBMITS A FALSE CERTIFICATION THAT IT IS A MICHIGAN BUSINESS OR FALSELY INDICATES THE STATE IN WHICH IT HAS ITS PRINCIPAL PLACE OF BUSINESS IS GUILTY OF A FELONY, PUNISHABLE BY A FINE OF NOT LESS THAN \$25,000 and subject to debarment under MCL 18.264.

BID BOND

BID SUBMITTED ON the _____ day of _____, 20_____.

Bid Security is in the form of a Bid Bond _____ Bid Bond form has been duly executed _____; or

A Bank Certified or Cashier's check ____ or Money Order ____ is attached to this page ____ (*If Bid Security is by Check or Money Order, the original check or money order must be delivered to the issuing office before Bid Due Time. ALL other SIGMA bid submittals are also still to be made.*)

If the Bidder is an Individual:

Name of Individual: _____

Name & Title of Person Authorized to sign: _____

Signature: _____
(If not the Individual, Attach Power of Attorney) Date

Doing Business as: _____

Business Address: _____

County of registration _____

Telephone: _____ FAX: _____

If the Bidder is a Partnership:

By: _____
(True Name of the Partnership)

Partner Authorized to Sign _____ Date

Signature: _____
(Attach evidence of Authority to sign) Date

Business Address: _____

County of registration _____

Telephone: _____ FAX _____

If the Bidder is a Corporation:

By: _____
(Legal Corporation Name)

Name & Title of Authorized Officer: _____

Signature: _____
(Attach evidence of Authority to sign) Date

Name & Title of Officer Attesting: _____

Signature: _____ Date

Business Address: _____

Telephone: _____ FAX _____

(State of Incorporation): _____

If The Bidder is A Joint Venture: JOINT VENTURE SIGNATURES MUST BE AS PROVIDED IN INSTRUCTIONS TO BIDDERS. EACH JOINT VENTURER SIGNING THE BID MUST SIGN IN THE MANNER INDICATED FOR AN INDIVIDUAL, A PARTNERSHIP OR A CORPORATION. IF MORE THAN TWO JOINT VENTURERS OF THE SAME TYPE ARE INCLUDED, USE ADDITIONAL PAGES. JOINT VENTURE STATE OF INCORPORATION _____ OR COUNTY OF REGISTRATION _____

POST-BID SUBMITTALS

The PSC will request this submittal after bid opening. Complete and submit these items within two business days after the request.

BIDDER'S EXPERIENCE MODIFICATION RATING (EMR) _____

Attach letter of explanation if the Bidder does not have an EMR.

PROPOSED PROJECT SUPERINTENDENT _____

Attach brief resume or list of similar successful projects.

LIST OF SIMILAR PROJECTS COMPLETED BY THE BIDDER

Please list at least three completed projects of similar size and complexity to the project being bid, with reference contact information

REFERENCE # _____

Owner: _____

Project/Contract Name: _____

Location of Project/Contract: _____

Contract Price: _____ Project/Contract Started: _____ Completed: _____

Owner's Representative (Name and Telephone): _____

Scope of Project/Contract: _____

REFERENCE # _____

Owner: _____

Project/Contract Name: _____

Location of Project/Contract: _____

Contract Price: _____ Project/Contract Started: _____ Completed: _____

Owner's Representative (Name and Telephone): _____

Scope of Project/Contract: _____

REFERENCE # _____

Owner: _____

Project/Contract Name: _____

Location of Project/Contract: _____

Contract Price: _____ Project/Contract Started: _____ Completed: _____

Owner's Representative (Name and Telephone): _____

Scope of Project/Contract: _____

POST BID SUBMITTALS: LIST OF SUBCONTRACTORS

The Apparent Low Bidder shall nominate for each Division of Specification and/or trade category, the Subcontractor to be awarded Sub-agreements, including the apparent Low Bidder if work is to be self-performed. Nominated subcontractors shall not be removed, replaced, or added to except by written request for good reason, subject to Owner acceptance.

Division, Specification Section and/or Trade	Nominated Subcontractor(s)	Amount of Subcontract
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____
13. _____	_____	_____
14. _____	_____	_____

The undersigned Apparent Low Bidder _____ certifies that all the information and data furnished in this List of Subcontractors are current, accurate and complete as of the date stated below.

Signed by: _____ Name _____ Title _____

on this _____ day of _____, 20_____.

PERFORMANCE BOND

SURETY COMPANY REFERENCE No. _____

That "the **Contractor**," _____, a corporation ____, individual ____, partnership ____, joint venture ____, of the State of _____, qualified to do business in the State of Michigan, as Principal, and "the Surety," _____, of the State of _____, as surety, are held and bound unto the State of Michigan, "the **Owner**," as Obligee, in the amount of _____ Dollars (\$ _____), for the payment of which the **Contractor** and Surety bind themselves, their respective heirs, successors, legal representatives and assigns, jointly and severally, in compliance with 1963 PA 213, as amended, MCL 129.201 et seq.

The **Contractor** has entered into "the Contract" with the **Owner** for _____, "the Work," covered by the Contract Documents, which are incorporated into this Performance Bond by this reference.

If the **Contractor** faithfully performs and fulfills all the undertakings, covenants, terms, conditions, warranties, indemnifications and agreements of the Contract Documents within the Contract Time (including any authorized changes, with or without notice to the Surety) and during the Correction Period, and if the **Contractor** also performs and fulfills all the undertakings, covenants, terms, conditions, warranties, indemnifications and agreements of any and all duly authorized modifications of the Contract Documents, then THIS OBLIGATION IS VOID, OTHERWISE TO REMAIN IN FULL FORCE AND EFFECT.

A. No change in Contract Price or Contract Time, "or equal" or substitution or modification of the Contract Documents (including addition, deletion, or other revision) releases the Surety of its obligations under this Section 00610 Performance Bond. The Surety expressly waives notice of any such change in Contract Price or Contract Time, "or equal" or substitution or

modification of the Contract Documents (including addition, deletion, or other revision).

B. This Performance Bond must be solely for the protection of the **Owner** and its successors, legal representatives or assigns.

C. It is the intention of the **Contractor** and Surety that they must be bound by all terms and conditions of the Contract Documents (including, but not limited to General Conditions and this Performance Bond). However, this Performance Bond is executed pursuant to 1963 PA 213, as amended, MCL 129.201 et seq., and if any provision(s) of this Performance Bond is/are illegal, invalid, or unenforceable, all other provisions of this Performance Bond must nevertheless remain in full force and effect, and the **Owner** must be protected to the full extent provided by 1963 PA 213, as amended, MCL 129.201 et seq.

IMPORTANT: The Surety must be authorized to do business in the State of Michigan by the Department of Licensing and Regulatory Affairs – Insurance Bureau, must be listed on the current U.S. Department of the Treasury Circular 570, and, unless otherwise authorized by the **Owner** in writing, must have at least an A– Best’s rating and a Class VII or better financial size category per current A. M. Best Company ratings.

Name, Address and Telephone of the Surety:

Address and Telephone of Agent, who is either a resident of, or whose principal office is maintained in, the State of Michigan

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

THE **CONTRACTOR**: (Print Full Name and Sign) By: _____

WITNESS _____ Name & Title: _____
Telephone No. _____

THE SURETY: (Print Full Name and Sign) Agent: _____

WITNESS _____ Attorney-in-Fact: _____
Telephone No. _____

PAYMENT BOND

SURETY COMPANY REFERENCE No. _____

"the **Contractor**," _____, a corporation _____, individual _____, partnership _____, joint venture _____ of the State of _____, qualified to do business in the State of Michigan, as Principal, and "the **Surety**," _____, of the State of _____, as surety, are held and bound unto the State of Michigan, "the **Owner**," as Obligee, in the amount of _____ Dollars (\$ _____), for the payment of which the **Contractor** and Surety bind themselves, their respective heirs, successors, legal representatives and assigns, jointly and severally, in compliance with 1963 PA 213, as amended, MCL 129.201 et seq.

The **Contractor** has entered into "the Contract" with the **Owner** for _____, "the Work," covered by the Contract Documents, which are incorporated into this Payment Bond by this reference.

If the **Contractor** promptly pays all claimants supplying labor or materials to the **Contractor** or to the **Contractor's** Subcontractors in the prosecution of the Work, then THIS OBLIGATION IS VOID, OTHERWISE TO REMAIN IN FULL FORCE AND EFFECT.

hereby expressly waives notice of any such change in Contract Price or Contract Time, "or equal" or substitution or modification of the Contract Documents (including addition, deletion, or other revision).

A. All rights and remedies on this Payment Bond are solely for the protection of all claimants supplying labor and materials to the **Contractor** or the **Contractor's** Subcontractors in the prosecution of the Work and must be determined in accordance with Michigan Law.

C. It is the intention of the **Contractor** and Surety that they must be bound by all terms and conditions of the Contract Documents (including, but not limited to this Payment Bond). However, this Payment Bond is executed pursuant to 1963 PA 213, as amended, MCL 129.201 et seq., and if any provision(s) of this Payment Bond is/are illegal, invalid, or unenforceable, all other provisions of this Payment Bond must nevertheless remain in full force and effect, and the **Owner** must be protected to the full extent provided by 1963 PA 213, as amended, MCL 129.201 et seq.

B. No change in Contract Price or Contract Time, "or equal" or substitution or modification of the Contract Documents (including addition, deletion, or other revision) must release the Surety of its obligations under this Payment Bond. The Surety

IMPORTANT: The Surety must be authorized to do business in the State of Michigan by the Department of Licensing and Regulatory Affairs – Insurance Bureau, must be listed on the current U.S. Department of the Treasury Circular 570, and, unless otherwise authorized by the **Owner** in writing, must have at least an A– Best's rating and a Class VII or better financial size category per current A. M. Best Company ratings.

Name, Address and Telephone of the Surety:

Address and Telephone of Agent, who is either a resident of, or whose principal office is maintained in, the State of Michigan

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

THE **CONTRACTOR**: (Print Full Name and Sign) By: _____

WITNESS _____ Name & Title: _____
Telephone No. _____

THE **SURETY**: (Print Full Name and Sign) Agent: _____

WITNESS _____ Attorney-in-Fact: _____
Telephone No. _____

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DIVISION 00

BIDDING REQUIREMENTS AND CONTRACT CONDITIONS

SECTION 00010 PRE-BID INFORMATION

1. **Invitation to Bid (ITB)** – Your firm is invited to submit a Bid. The State of Michigan as the Owner will receive **bids electronically through the SIGMA VSS website at <https://sigma.michigan.gov/webapp/PRDVSS2X1/AltSelfService>**, for renovate armory at the Detroit Light Guard Armory until 2:00 p.m., ET, on July 12, 2023. The State reserves the right to cancel this Invitation to Bid (ITB) or change the date and time for submitting Bids by announcing same at any time before the established date and time for Bid opening. Bids must remain open for acceptance by the Owner for no less than the Bid hold period. Contractor may agree to extend the Bid hold period. However, any such extension must be based upon no increase in the Bid Price and/or Contract Time.

2. **Work Description** – The Work, renovate armory and other related items at the Detroit Light Guard Armory, Agency No. 511, Funding Code. 1340, DTMB File No. 511/23337.AGY includes, but is not necessarily limited to:

Provide all labor, equipment, and materials to renovate armory and all related work at the Detroit Light Guard Armory, in accordance with these specifications and accompanying drawings, DMVA Project No. 26A8023010.

The site is located at the Detroit Light Guard Armory, 4400 E. 8 Mile Road, Detroit, MI 48234, as shown on the Drawings.

3. **Bidding Documents** – Sets of Bidding Documents may be obtained at <https://sigma.michigan.gov/webapp/PRDVSS2X1/AltSelfService>.

4. **Bid Security** – Each Bid must enclose a duly executed Bid Security, in the amount of five percent (5%) of the Bidder's Base Bid, paid to the "State of Michigan" in the form of a certified or cashier's check or money order drawn upon a bank insured by an agency of the Federal Government, or a bid bond signed by both the Contractor and authorized surety company. *If Bid Security is by check or money order, such certified or cashier's check or money order must be delivered in original copy before the Bid Due Time to:*

State Facilities Administration
Design & Construction Division
3111 W. St. Joseph Street
Lansing, Michigan 48917

All other Bid information must be submitted via SIGMA as per standard bidding procedure

5. **Pre-Bid Conference** – A **mandatory** pre-bid conference will be held at Detroit Light Guard Armory, 4400 E. 8 Mile Road, Detroit, MI on June 21, 2023 at 10:00am ET. A tour will be held on the same day, starting after the pre-bid conference. All prospective Bidders are required to attend the tour, if held. Other parties interested in the Work are encouraged to attend the tour. Addenda may be issued, in response to issues raised at the pre-bid conference and tour, or as the Owner and/or Professional may otherwise consider necessary.

The purpose of the pre-bid conference and inspection is to answer questions and provide an inspection tour of the Project site at the scheduled time on the day of the meeting. A representative will be available to assist the Contractors. Other inspection visits may be allowed if needed. Individuals needing special services to fully participate in the meeting due to a disability may contact Doug Shilling at (517) 599-6881. **An individual is only permitted to represent one bidder at a mandatory Pre-Bid Conference.**

6. **SIGMA VENDOR NUMBER:** If you are bidding a State job for the first time, visit the State of Michigan SIGMA website, <https://sigma.michigan.gov/webapp/PRDVSS2X1/AltSelfService>, and follow the "SOM VSS User Guide for New Vendors" instructions, located under Forms and Reference Documents. Registration is required for bid submission. **Do not wait until the last minute to submit a proposal**, as the SIGMA system requires the creation of an account and entry of certain information, in addition to uploading and submitting the materials. The SIGMA system **will not** allow a proposal to be submitted after the proposal deadline, even if a portion of the proposal has been updated.

Questions on how to submit information or how to navigate in the SIGMA VSS system can be answered by calling **(517) 373-4111 or (888) 734-9749**.

7. **Equal Employment Opportunity** – Covenants to not discriminate in employment by Contractors, Subcontractors and Suppliers required by Law are contained in Instructions to Bidders and General Conditions and are applicable to the Work and any Sub-agreement under the Contract.

8. **Contract Times** – The Contract Times and the associated liquidated damages are specified in the Contract.

9. **Contact Person** – All requests or inquiries concerning the Bidding Documents, or the Work must be addressed to: Karrie Baker at bakerk7@michigan.gov. Questions will be accepted until June 28, 2023 10:00am ET.

10. **Award** – Subject to any agreed extension of the period for holding Bids, Bids must remain valid for acceptance by the Owner for 60 Calendar Days after the date of Bid opening. In addition, the Owner expressly reserves the right, within the Owner's sole discretion, to reject any or all Bids, to waive any irregularities, to issue post-Bid Addenda and re-bid the Work without re-advertising, to re-advertise for Bids, to withhold the award for any reason the Owner determines and/or to take any other appropriate action.

11. **Performance and Payment Bonds** – A performance bond and a payment bond are required for all contracts over \$50,000.00.

END OF SECTION 00010

SECTION 00100 INSTRUCTIONS TO BIDDERS

1. **PREPARATION OF BID:** Execute Bid fully and properly. Bid Summary Form (DTMB -0401D) and Bid Form Attachments must be used and completely filled out for the Bid to be considered responsive and meeting the requirements of the contract solicitation. All Bid prices must be printed or typed in both words and figures.
2. **BID CHECKLIST:** Submit Bid Summary Form with original signatures plus Bid Form Attachments in accordance with the electronic bidding procedures on the SIGMA VSS website.

A complete Bid will consist of the following forms, which are included immediately following the Bid Summary Form:

<u>Bids</u>	<u>SUBMIT THESE Bid Forms and Bid Form Attachments</u>
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- | | |
|----------|---|
| All Bids | <input type="checkbox"/> Signed and completed Bid Summary Form (DTMB-0401D).
<input type="checkbox"/> Bid Schedule.
<input type="checkbox"/> Qualified Disabled Veteran (QDV) Business Representation.
<input type="checkbox"/> Bid Security in the amount of 5% of Base Bid Price. |
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If Bid Security is by check or money order, such certified or cashier's check or money order must be delivered in original copy before the Bid Due Time to:

State Facilities Administration
 Design & Construction Division
 3111 W. St. Joseph Street
 Lansing, Michigan 48917

All other Bid information must be submitted via SIGMA as per standard bidding procedure

- | | |
|-------------|--|
| Over \$50K | <input type="checkbox"/> Signature Authorization or copy of the partnership agreement if signed by all partners.
<input type="checkbox"/> Other Forms |
| Over \$100K | <input type="checkbox"/> Forms listed under All Bids.
<input type="checkbox"/> Payment and Performance Bond (upon issuing the Notice of Award). |
| Over \$250K | <input type="checkbox"/> Forms listed under All Bids.
<input type="checkbox"/> Certification of a Michigan Based Business.
<input type="checkbox"/> Payment and Performance Bond (upon issuing the Notice of Award). |

Apparent Low Bidders ONLY (upon request from the Professional)

- Experience Modification Rating (EMR), or a letter stating why the Bidder does not have one.
- Identification of the proposed project superintendent, with a resume or list of similar projects handled by that individual.
- A list of at least three (3) projects completed by the Bidder, within the last three (3) years of similar size and complexity, with contact information for references for each.
- A list of nominated sub-contractors, including proposed self-performed categories, for each Division/Trade/etc.

3. **BID SUBMISSION:** Bids must be submitted electronically through the SIGMA VSS website at <https://sigma.michigan.gov/webapp/PRDVSS2X1/AltSelfService>.

4. **BID GUARANTEE:** Each proposal must be accompanied by either a bank certified or cashier's check on an open, solvent bank or a bid bond with an authorized surety company (the surety must be listed on the current U.S. Department of the Treasury Circular 570) in the amount of five percent of the base bid payable to the State of Michigan, as a guarantee of good faith. If the successful Bidder fails to furnish satisfactory bonds and insurance within fifteen Calendar Days after Notice of Award, such guarantee must be forfeited to the State as liquidated damages. *If Bid Security is by check or money order, such certified or cashier's check or money order must be delivered in original copy before the Bid Due Time to the Issuing Office.* The bid security, exclusive of bid bonds, of all unsuccessful Bidders will be returned when an award is made or upon substitution of a bid bond. The bid security of the successful Bidder will be returned when the performance bond and labor and material bond are approved.
5. **Left Blank Intentionally.**
6. **MICHIGAN BASED BUSINESS CERTIFICATION:** All Bidders submitting Bids in excess of \$100,000.00 must complete the Certification of Michigan Based Business. This information will determine if a Bidder qualifies as a "Michigan" business for purposes of application of reciprocity where applicable.
7. **POST-BID SUBMITTAL: For all projects, the Professional may request a Post-Bid Submittal from the Apparent Low Bidders.** The Apparent Low Bidders must submit to the Professional, within **two** Business Days after receipt of the Professional's request,
 - Experience Modification Rating (EMR), or a letter stating why the Bidder does not have one.
 - Identification of the proposed project superintendent with a resume or list of similar projects managed by that individual.
 - A list of at least three (3) projects completed by the Bidder, within the last three (3) years of similar size and complexity, with contact information for references for each.**Failure to provide the submittals may disqualify the Bid.**
8. **SIGNATURES:** All Bids, notifications, claims, and statements must be signed as follows:
 - (a) **Corporations:** Signature of official must be accompanied by a certified copy of the Resolution of the Board of Directors authorizing the individual signing to bind the corporation.
 - (b) **Partnerships:** Signature of one partner must be accompanied by a signed copy of the legal document (e.g., Power of Attorney or partnering agreement) authorizing the individual signing to bind all partners. If Bid is signed by all partners, no authorization is required.
 - (c) **Individual:** No authorization is needed. Each signature must be witnessed.
9. **BID PRICES:** The Bidder's Base Bid and Alternate Bid prices must include, and payment for completed Work will compensate in full for: all services, obligations, responsibilities, management, supervision, labor, materials, devices, equipment, construction equipment, general conditions, permits, patent fees and royalties, testing, inspection and approval responsibilities, warranties, temporary facilities, small tools, supplies, Bonds, insurance, taxes, mobilization, close-out, overhead and profit and all connections, appurtenances and any other incidental items of any kind or nature, as are necessary to complete the Work, in a neat, first quality, workmanlike and satisfactory manner in accordance with the Drawings and Specifications and as otherwise required to fulfill the requirements of the Bidding Documents. For each Cash Allowance item, the Bidder must include, within the Bid, all labor costs, construction equipment costs, insurance and Bond premiums and other general conditions costs and Fees (Bidder's and Subcontractors') to complete Work associated with the material, equipment, or other designated item to be furnished under the Cash Allowance. For each Provisionary Allowance, the Bidder must include, within the Bid, insurance, premiums (not recoverable as labor burden) and Bond premiums required to complete Work that may be ordered under a Provisionary Allowance.
10. **INSPECTION OF BIDDING DOCUMENTS AND SITE CONDITIONS:** The Bidder must carefully review and inspect all documents referenced and made part of this ITB, site conditions, all applicable statutes, regulations, ordinances, and resolutions addressing or relating to the goods and services under this contract. Failure to do so or failure to acquire clarifications and answers to any discovered conflicts, ambiguities, errors, or omissions in the Bidding Documents will be at the Bidder's sole risk.
11. **SAFETY REQUIREMENTS AND LAWS:** The Bidder awarded the Contract must comply with all applicable federal, state, and local Laws including health and safety regulations, environmental protection, permits and licensing.
12. **INTERPRETATIONS AND ALTERATIONS TO THE BID AND BIDDING DOCUMENTS:** All requests for clarification or interpretation of the Bidding Documents, all proposals for any modifications to the Bidding Documents, all requests for information and all other questions or inquiries about the Bidding Documents and/or the Work shall be submitted in writing to the Contact Person identified in the Bid Documents. Requests or inquiries received less than seven Calendar Days before the date of Bid opening will be answered only if (a) the response can be given through an Addendum made available at least seventy-two hours before Bid opening (counting Business Days only), (b) the Bid opening is postponed by Addendum, or (c) the Work is rebid without readvertising following the issuance of post-Bid Addenda.

Bidders must not rely upon any oral statements or conversations regarding interpretations, clarifications, corrections, additions, deletions or other revisions or information to the Bidding Documents. Any addition, limitation or provision made with or attached to the Bid may render it non-responsive and/or irregular and be a cause for rejection. The Owner reserves the right to issue a

post-Bid Addendum after opening the Bids and set a new date for the receipt and opening of sealed Bids. The Bidder acknowledges that any quantities of Unit Price Work given in this ITB are approximate only and payments will be made only for actual quantities of Unit Price Work completed in accordance with the Contract Documents.

- 13. MODIFICATION OF BID:** The entire bid must be resubmitted on the SIGMA VSS website.
- 14. BID WITHDRAWAL:** Except for timely filed claims of mathematical or clerical errors granted by the State, no Bid may be withdrawn within sixty Calendar Days after the Bid Opening time and date or before the Bid expiration date without forfeiting Bid security. The request to withdraw a Bid due to error must be submitted in writing along with the supporting documents within two Business Days after the date of Bid Opening. The claim must describe in detail the error(s), include a signed affidavit stating the facts of the alleged error(s) and request that the Bidder be released from its Bid. The review of the claim and its supporting documents by the State is only for the purpose of evaluating the Bidder's request and must not create duty or liability on the State to discover any other Bid error or mistake. The sole liability of any Bid error or mistake rests with Bidder.
- 15. OBJECTION TO THE AWARD:** A Bidder may file a written protest with the Director-DCD to object to the Apparent Low Bidder. This objection must be filed within seven Calendar Days after the date of Bid opening and must describe in detail the basis for the protest and request a determination. The Director-DCD will either dismiss or uphold the protest and notify the protestor within ten Calendar Days after receipt of the written protest.
- 16. BID IRREGULARITIES:** The following irregularities on any Bid Form or Bid Form Attachment must be resolved as follows:
- between SIGMA entry and signed Bid Summary attachment, the signed Bid Summary attachment will be used.
 - between words and figures, the words must be used.
 - between any sum, computed by the Bidder, and the correct sum, the sum computed by the Bidder must be used.
 - between the product, computed by the Bidder, of any quantity and Bid Unit Price and the correct product of the Unit Price and the quantity of Unit Price Work, the product extended by the Bidder must be used.
 - between a stipulated Allowance and the amount entered, the Allowance must be used.
 - any mobilization pay item exceeding the maximum specified must be ignored and the Bid must remain unchanged.
 - if any Bidder fails or neglects to bid a Unit Price for an item of Unit Price Work but shows an "Bid Price" for that item, the missing unit price must be computed from the respective quantity and the Item Bid Price shown.
 - if any Bidder fails or neglects to show a "Bid Price" for an item of Unit Price Work but bids a unit price, the missing Bid Price must remain as "zero"; and
 - if any Bidder fails or neglects to enter a Bid Price in both words and figures, the Bid Price printed or typed, whether in words or figures, must be used.
- 17. CERTIFICATION:** The bidder certifies to the best of its knowledge and belief that, within the past three (3) years, the bidder, an officer of the bidder, or an owner of a 25% or greater interest in the bidder:
- Has not been convicted of a criminal offense incident to the application for or performance of a contract or subcontract with the State of Michigan or any of its agencies, authorities, boards, commissions, or departments.
 - Has not had a felony conviction in any state (including the State of Michigan).
 - Has not been convicted of a criminal offense which negatively reflects on the bidder's business integrity, including but not limited to, embezzlement, theft, forgery, bribery, falsification, or destruction of records, receiving stolen property, negligent misrepresentation, price-fixing, bid rigging, or a violation of state or federal anti-trust statutes.
 - Has not had a loss or suspension of a license or the right to do business or practice a profession, the loss or suspension of which indicates dishonesty, a lack of integrity, or a failure or refusal to perform in accordance with the ethical standards of the business or profession in question.
 - Has not been terminated for cause by the Owner.
 - Has not failed to pay any federal, state, or local taxes.
 - Has not failed to comply with all requirements for foreign corporations.
 - Has not been debarred from participation in the bid process pursuant to Section 264 of 1984 PA 431, as amended, MCL 18.1264, or debarred or suspended from consideration for award of contracts by any other State or any federal Agency.
 - Has not been convicted of a criminal offense or other violation of other state or federal law, as determined by a court of competent jurisdiction or an administrative proceeding, that in the opinion of DTMB indicates that the bidder is unable to perform responsibly or which reflects a lack of integrity that could negatively impact or reflect upon the State of Michigan, including but not limited to, any of the following offenses under or violations of:
 - The Natural Resources and Environmental Protection Act, 1994 PA 451, MCL 324.101 to 324.90106.
 - A persistent and knowing violation of the Michigan Consumer Protection Act, 1976 PA 331, MCL 445.901 to 445.922.
 - A finding that the bidder failed to pay the wages and/or fringe benefits due within the time period, as may be required by applicable law.
 - Repeated or flagrant violations of 1978 PA 390 MCL 408.471 to 408.490 (law relating to payment of wages and fringe benefits).
 - A willful or persistent violation of the Michigan Occupational Health and Safety Act, 1974, PA 154, MCL 408.10001 to 408.1094, including: a criminal conviction, repeated willful violations that are final orders, repeated violations that are final orders, and failure to abate notices that are final orders.
 - A violation of federal or state civil rights, equal rights, or non-discrimination laws, rules, or regulations.
 - Been found in contempt of court by a Federal Court of Appeals for failure to correct an unfair labor practice as prohibited by Section 8 of Chapter 372 of the National Labor Relations Act, 29 U. s. C. 158 (1980 PA 278, as amended, MCL 423.321 et seq).

- (j) Is not an Iran-Linked Business as defined in MCL 129.312.

A false statement, misrepresentation, or concealment of material facts on this certification may be grounds for rejection of this proposal or termination of the award and may be grounds for debarment.

- 18. REJECTION OF BID:** The Bidder acknowledges the right of the Owner to reject any Bids and to waive any informality, defects or irregularity in any Bid received. In addition, the Bidder recognizes the right of the Owner to reject a Bid if:
- the Bid is in any way incomplete or irregular.
 - the Bidder, Subcontractor or Supplier is not responsible as determined by the Owner.
 - the Bidder's performance as a Contractor was unsatisfactory under a prior Contract with the Owner for the construction, repair, modification, or demolition of a facility with the Owner, or under any other Contract, which was funded, directly or indirectly, by the Owner.
 - there are reasonable grounds for believing that collusion or unlawful agreements exists between any Bidders, that a Bidder is interested in more than one Bid, or that the Bid is not genuine.
 - the Bid exceeds the funds available.
- 19. MATERIALS AND EQUIPMENT SUBSTITUTION:** Any Bidder wishing to use manufacturers or materials other than those specified must submit a written request to the Professional not later than seven days before due date for Bids. Request must be accompanied by product data to permit evaluation and comparison with specified products or materials. The Person submitting the request will be responsible for its prompt delivery. The Professional and the Owner will examine and evaluate the product data and if found acceptable, an Addendum will be issued and mailed or delivered to each Person who has received a set of Drawings and Specifications. All Addenda incurred must be made a part of the Contract requirements. Contractor will be responsible for any extra work and expense incurred to satisfactorily and completely incorporating each substitute product into the Project.
- 20. MICHIGAN PRODUCTS AND RECYCLED PRODUCTS:** All Contractors and Suppliers are encouraged to provide Michigan-made products and/or recycled products and/or green products and/or environmentally friendly products whenever possible where price, quality, and performance are equal to, or superior to, non-Michigan products and the requirements of the Contract Documents. The Contractor will be required to use alternatives to landfills for waste disposal such as reuse or recycle of asphalt, bricks, concrete, masonry, plastics, paint, glass, carpet, metals, wood, drywall, insulation, and any other waste materials to the extent practical.
- 21. PRE-AWARD PRODUCT SUBMITTALS:** If requested, the Apparent Low Bidders must submit a summary of preliminary technical data on each product listed in **Section 034001 Precast Concrete Retaining Wall System, 102233 Accordion Folding Partitions, 235216 Condensing Boilers, 236313 Air Cooled Condensers, 237313 Modular Indoor Air Handling Unit, 263213 Engine Generators, and 335213 Fuel Distribution and Storage**. The Apparent Low Bidders will furnish this summary data to the Professional within forty-eight hours of the Bid Opening. These submittals will be used to evaluate the Bid before the award. Failure to provide the submittals may disqualify the Bid.
- 22. CONTRACT AND CONTRACT AWARD:** The Owner intends to award a Contract to the responsive and responsible best value bidder, except as provided below relative to veteran's preference.
- 22.1 Determination of the lowest three Bidders shall be based on the sum of the Base Bid and any additive and deductive Alternates the Owner accepts, in the order in which they are listed only. The Owner will accept an Alternate only if all other previously listed Alternates are also accepted unless acceptance by the Owner of Alternates in a different order does not affect determination of the lowest three bidders in any way.
- 22.2 The bids will be evaluated for best value based on price and qualitative components by comparing the qualitative components of the three lowest responsive and responsible Bidders. The comparison may also include other Bidders whose bids are within 10% of the lowest responsive and responsible Bidder.
- 22.3 If a Qualified Disabled Veteran meets the requirements of the contract solicitation, provides acceptable responses to both Part One and Part Two of the Best Value Construction Bidder Evaluation to achieve a Best Value recommendation and with the veteran's preference is the lowest responsive, responsible, best value Bidder, the Owner will award the contract to the Qualified Disabled Veteran bidder. A determination as to whether the requirements of the bid solicitation have been met will be based solely on the Owner's and Professional's evaluation of the Bid Summary, Bid Attachments, Bidder-provided documents, and interview.
- 22.4 For the purpose of evaluating and determining the low responsive bid, 10% of the lowest responsive bid (the bid that would otherwise receive the contract award if the preference were not being considered) will be deducted from all QDV bids. If the low responsive QDV bid, less the 10% preference, is less than the lowest responsive bid, then the QDV bid will be declared the official low responsive bid. The original QDV bid amount will be the basis of the contract award.

Example:

Lowest Responsive Bid	\$100,000
Lowest Responsive QDV Bid	\$109,000
Preference (10% of the Lowest Responsive Bid)	\$ 10,000
Lowest Responsive QDV Bid Less Preference	\$ 99,000 (\$109,000 - \$10,000)
Official Low Responsive Bid	\$109,000

22.5 The Apparent Low Bidders will be evaluated for responsiveness and responsibility based on the following:

- Compliance with the bid specifications and requirements.
- The Bidder's financial resources.
- The Bidder's technical capabilities.
- The Bidder's technical experience.
- The Bidder's past performance.
- The Bidder's insurance and bonding capacity.
- The Bidder's business integrity.

Some qualitative components that may be evaluated are:

- Technical approach.
- Quality of proposed personnel.
- Management plans.

22.6 For contracts under \$250,000, best value will primarily be based on the lowest responsive and responsible bid.

23. CONTRACT TIME; LIQUIDATED DAMAGES: Work of all trades as specified in the Contract Documents must be completed in 365 calendar days from the date of Notice-to-Proceed except for minor replacement, correction, or adjustment items which do not interfere with the complete operation and utilization of all parts of the Contract Work. This Contract Time is of the essence and liquidated damages for each Calendar Day that expires after this Substantial Completion of the entire Work must be in the amount of \$200. Liquidated damages are not a penalty, are cumulative and represent a reasonable estimate of the Owner's extra costs and damages, which are difficult to estimate with accuracy in advance.

24. MOBILIZATION: If used in the Specifications/Bid schedule, all the up-front costs incurred by the Contractor must be covered by the mobilization. The costs to establish temporary site offices, to obtain required permits for commencing the Work and for bonds and insurance premiums are examples of costs to the Contractor that are covered by mobilization pay item. This cost must not exceed four percent (4%) of the Base Bid, unless otherwise expressly provided in the Bidding Documents.

25. SOIL EROSION AND SEDIMENTATION CONTROL: All Work under this Contract must meet the storm water management requirements of the Project and comply with the applicable Soil Erosion and Sedimentation Control (SESC) rules and regulations and specific provisions for same within the Contract Documents. SESC measures will be monitored and enforced by the State Facilities Administration, or another authorized enforcing agency if so delegated, through the review of the Contractor's implementation plans and site inspections. State Facilities Administration or the Professional will notify the Contractor in writing of any violation(s) of the applicable SESC statutes and/or the corrective action(s) undertaken by the Owner and may issue stop work orders. State Facilities Administration has the right to assess a fine to the Contractor for noncompliance with the provisions of the Contract Documents and/or SESC regulations applicable to this Work and fines must be in addition to any other remediation costs or liquidated damages applicable to the Project and may exceed the value of the Contract.

END OF SECTION 00100

SECTION 00120 SUPPLEMENTARY INSTRUCTIONS – Not Used.

END OF SECTION 00120

SECTION 00200 INFORMATION FOR BIDDERS

1. UNDERGROUND UTILITIES

Information or data about physical conditions of existing Underground Utilities, which have been used by the Professional in preparing the Bidding Documents, is shown, or indicated in the Drawings and technical Specifications.

2. PERMITS, APPROVALS, LICENSES AND FEES

2.1 If the Owner has secured or will secure any permits, approvals and licenses and has paid or will pay any associated charges and fees, any such permits, approvals and licenses are itemized in this paragraph: **None provided by the Owner.**

- 2.2 If any permits, approvals, and licenses itemized above have been obtained by the Owner and the fees have been paid, copies of those permits, approvals, licenses, and corresponding fee receipts, are attached to this Section 00200 Information for Bidders.

Except for any permits, approvals, licenses, and fees identified above, the **Contractor shall be responsible for all permits, approvals, licenses, and fees applicable to Work.**

3. SEQUENCING REQUIREMENTS

Refer to the technical Specifications, including, but not limited to the General Requirements, for information, data, and criteria on sequences of Work restraints, construction, and maintenance of service to existing facilities, which, if provided, must govern the selection of Work sequences. Each Bidder must be responsible for any conclusions or interpretations the Bidder makes related to the selection of sequences and Means and Methods, based on the technical data made available, and/or those additional investigations or studies made or obtained by that Bidder.

END OF SECTION 00200

SECTION 00700 GENERAL CONDITIONS

1. **Interpretations:** Any requests for clarifications or interpretations of the Contract Documents must be in writing to the Professional, who will issue written clarifications or interpretations as appropriate. If the Contractor believes that such clarification or interpretation justifies an adjustment to the Contract Price/Time, the Contractor must promptly notify the Professional in writing before proceeding with the Work Involved.
- 1.1 **Standards:** The Contract Documents describe the entire Work. The provisions of the Contract Documents must govern over any standard specifications, manual or code of any technical society, organization, or association but, if lower than the standards set by any Law applicable to the Work or the Project, the higher standards must govern. The Contractor's responsibilities extend to cover Subcontractors and Suppliers if liable as a result of their actions or obligations.
- 1.2 **Contract Time Computation:** The time to complete the Work must be made in Calendar Days and must include both the first and last day. The first day is established by the Notice-to-Proceed.
- 1.3 **Technical Specifications and Priority:** The following applies whenever priority is called for in Contract Documents: specifications must govern Drawings; figured dimensions must govern scaled dimensions; detail drawings must govern general drawings; Drawings must govern Submittals.
- 1.4 **Indemnification:** The Contractor is required to defend, indemnify and hold harmless the Owner and the Professional, their employees, agents, servants, and representatives from and against all claims, suits, demands, actions of whatever type and nature and all judgments, costs, losses and damages, whether direct, indirect or consequential including, but not limited to, charges of architects, engineers, attorneys and others and all court, hearing and any other dispute resolution costs arising from:
- (a) any patent or copyright infringement by the Contractor.
 - (b) any damage to the premises or adjacent lands, areas, properties, facilities, rights-of-way, and easements, including loss of use to the business and property of others as a result of Contractor's operations.
 - (c) any bodily injury, sickness, disease or death, or injury to or destruction of property, including loss of use due to or related to the Work and caused in whole or in part by the Contractor or Subcontractor or Supplier's negligence, omissions, or failure to maintain the required insurance and coverage and,
 - (d) a failure by the Contractor to appropriately handle Hazardous Materials for the Work or the Contractor's operations in compliance with the Owner requirements and/or applicable Laws and regulations.

The indemnification obligations are not affected by the limitation on the amount and types of damages, compensation or benefits payable by or for the Contractor or Subcontractor or Supplier under worker's or workman's compensation acts, disability benefit acts or other employee benefit acts.

- 1.5 **Contract Documents Ownership:** The State is the owner of the Contract Documents. The Contractor, Subcontractor or Supplier must not reuse any of the documents on any other Project without prior consent of the State and Professional. The Professional will furnish on behalf of the Owner at no cost to the Contractor, one (1) electronic copy of the Drawings and Project Manual. If the **Contractor**, or the Contractor's Subcontractors or Suppliers request hard copy sets, reproduction of these documents will be the responsibility of the **Contractor**.

2. GENERAL PROVISIONS

- 2.1 **Owner:** The Project Director and/or Owner Field Representative will represent the Owner. Neither the Project Director nor the Owner Field Representative has the authority to interpret the requirements of the Contract Documents or to authorize any changes in the Work or any adjustment in Contract Price/Time. The State will provide the necessary easements for permanent structure and permanent changes in existing lands, areas, properties, and facilities. However, the Contractor must obtain, at no

increase in Contract Price/Time, permits for any other lands, areas, properties, facilities, rights-of-way, and easements required by the Contractor for temporary facilities, storage, disposal of soil or waste material or any other purpose. The Contractor must submit copies of the permits and written agreements to the Owner. The Contractor must engage a registered land surveyor to establish the necessary reference points and/or base lines for construction and must be responsible for protecting them including benchmarks and Project elevations.

2.2 **Professional:** Acting as the Owner's representative during the Contract Time period, the Professional will endeavor to guard the Owner from Defective work and to keep the Owner informed of the progress of the Work. Unless delegated by specific written notice from the Owner, the Professional and the Professional's representatives do not have the authority to authorize any changes in the Work or any adjustment in Contract Price/Time. The On-site Inspections by the Owner Field Representative and/or the Professional do not relieve the Contractor from its obligation to provide the Work in accordance with the Contract Documents or represent acceptance of Defective Work.

2.3 **Contractor:** The Contractor must manage, supervise, and direct the Work competently, applying the management, supervision, skills, expertise, scheduling, coordination, and attention necessary to provide the Work in accordance with the Contract Documents with a minimum disturbance to or interference to the business operations on site or adjacent properties. The Contractor must assign and maintain a competent full-time **superintendent** on the Work, as its representative, at all times while Work is being done on site and must not be replaced without the Owner's consent. The Contractor shall enforce good order among its employees and shall not employ on the work any disorderly, intemperate, or unfit persons, or not skilled in the work assigned to them. The Contractor is solely responsible for his Means and Methods, safety precautions and programs related to safety, the Contractor's failure to execute the Work in accordance with the Contract Documents and any act of omissions by the Contractor, Subcontractor or Supplier. The Contractor must **compare Contract Documents for conflicts**, unworkable or unsafe specified Means and Methods and verify against manufacturer's recommendations for installations and handling and must notify the Professional in writing of the discovery of any such conflicts or errors. The Contractor is required to furnish certifications that lines and grades for all concrete work were checked before and after placing concrete, and that final grades are as required by the Contractor Documents. Wherever required, the Contractor must be responsible for all cutting, fitting, drilling, fixing-up, and patching of concrete, masonry, gypsum board, piping and other materials that may be necessary to make in-place Work and dependent Work fit together properly. The Contractor must restore to pre-existing conditions all walks, roadways, paved or landscaped areas and other real and personal property not designated for alteration by the Contract Documents. The Contractor must maintain at the site one copy of safety data sheets (SDS) and one copy of all **as built/Record Documents** in good order and annotated in a neat and legible manner to show:

- (a) all revisions made,
- (b) dimensions noted during the furnishing and performance of the Work, and
- (c) all deviations between the as-built installation and the Contract Documents, all approved Submittals and all clarifications and interpretations.

The Contractor must maintain and furnish promptly to the Owner and the Professional upon their request **daily field reports and photos** recording the on-site labor force and equipment (Contractor and Subcontractors); materials/equipment received; visits by Suppliers; significant in-progress and completed trade Work within major areas; and other pertinent information. The Contractor is obligated to act to prevent threatened damage, death, injury, or loss without any special instruction in **emergencies** and must give the Owner prompt written notice of any changes in Work resulting from the action taken for review and approval.

2.4 **Subcontractors and Suppliers:** The Owner assumes no contractual obligations to anyone other than the Contractor. All trade construction Drawings must be field coordinated before fabrication and/or installation. The Owner reserves the right to reject or revoke, for its convenience, any approved Subcontractor/Supplier. Work performed by any Subcontractor or Supplier must be through an appropriate written agreement that:

- (a) expressly binds the Subcontractor/Supplier to the requirements of the Contract Documents,
- (b) requires such Subcontractor or Supplier to assume toward the Contractor all the obligations that the Contractor assumes toward the Owner and the Professional, and
- (c) contains the waiver of rights and dispute resolution provisions.

2.5 **Access to Payroll Records:** The Contractor and its Subcontractors must, to the extent applicable, comply with the Prevailing Wage Rates for the county where the Project is located, and must maintain and keep, in accordance with generally accepted accounting principles, records pertaining to the bidding, award and performance of the Work, including, but not limited to certified payroll, employment records and all data used in estimating the Contractor's prices for the Bid, Change Order, proposal or claim. The Owner or its representative must have access to those records, must have the right to interview the Contractor's employees and must be provided with appropriate facilities for the purpose of inspection, audit/review and copying for five years after final payment, termination, or date of final resolution of any dispute, litigation, audit exception or appeal. The payroll and other employment records of workers assigned to the site must contain the name and address of each worker, correct wage classification, rate of pay, daily and weekly number of hours worked, deduction made, and actual wages paid. The Contractor must maintain records that show: (a) the anticipated costs or actual costs incurred in providing such benefits, (b) that commitment to provide such benefits is enforceable, and (c) that the plan or program is financially responsible and has been communicated in writing to the workers affected.

3. Bonds and Insurance:

- 3.1 Both the Performance Bond and Payment Bond must remain in effect from the date of Contract Award until final completion of the Work or the end of Correction Period, whichever comes later. The surety bonds required for a Construction Contract will not be accepted by SFA unless the surety bonding company is listed in the current United States Government, Department of Treasury's, Listing of approved sureties (bonding/insurance companies), Department Circular 570. Copies of the current Circular listing may be obtained through the internet web site <https://www.fiscal.treasury.gov/fsreports/ref/suretyBnd/c570.htm>.

Insurers must have an "A-" A.M. Best Company Rating and a Class VII or better financial size category as shown in the most current A.M. Best Company ratings. Insurance must be provided by insurers authorized by the Department of Insurance and Financial Services (DIFS) to do business as an insurer in Michigan. The insurance company and must attach evidence of the authorization. These certificates must specify the Project File No., Funding Code., Project Title, and a description of the Project. The Contractor agrees that insurance coverage afforded under the policies as such coverage relate to the State under this Contract as determined by the Contractor will not be modified or canceled without at least thirty calendar days prior written notice to the State. The latest A.M. Best's Key Ratings Guide and the A.M. Best's Company Reports (which include the A.M. Best's Ratings) are found at: <http://www.ambest.com>. The Contractor must not perform any part of the Work unless the Contractor has all the required insurance in full force and effect.

- 3.2 The Contractor is required to provide proof of the minimum levels of insurance coverage as indicated below. The purpose of this coverage must be to protect the State from claims which may arise out of or result from the Contractor's performance of services under the terms of this Contract, whether such services are performed by the Contractor, or by any subcontractor, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.

The Contractor waives all rights against the State for recovery of damages to the extent these damages are covered by the insurance policies the Contractor is required to maintain pursuant to this Contract. The Contractor also agrees to provide evidence that all applicable insurance policies contain a waiver of subrogation by the insurance company.

All insurance coverages provided relative to this Contract/Purchase Order is PRIMARY and NON-CONTRIBUTING to any comparable liability insurance (including self-insurances) carried by the State.

The Insurance must be written for not less than any minimum coverage herein specified or required by law, whichever is greater. All deductible amounts for any of the required policies are subject to approval by the State.

The State reserves the right to reject insurance written by an insurer the State deems unacceptable.

BEFORE THE CONTRACT IS SIGNED BY BOTH PARTIES and BEFORE THE PURCHASE ORDER IS ISSUED BY THE STATE, THE CONTRACTOR MUST FURNISH TO THE DIRECTOR-DCD CERTIFICATE(S) OF INSURANCE VERIFYING INSURANCE COVERAGE. THE CERTIFICATE MUST BE ON THE STANDARD "ACCORD" FORM. THE CONTRACT OR PURCHASE ORDER NUMBER MUST BE SHOWN ON THE CERTIFICATE OF INSURANCE TO ASSURE CORRECT FILING. All such Certificate(s) are to be prepared by the Insurance Provider and not by the Contractor. All such Certificate(s) must contain a provision indicating that coverages afforded under the policies WILL NOT BE CANCELLED, MATERIALLY CHANGED, OR NOT RENEWED without THIRTY days prior written notice, except for 10 days for non-payment of premium, having been given to the Director-DCD. Such NOTICE must include the CONTRACT NUMBER affected and be mailed to the Project Director.

The Contractor is required to provide the type and amount of insurance below:

- (a) Commercial General Liability Insurance with a limit of not less than \$1,000,000 each occurrence. If such CGL insurance contains a general aggregate limit, it must apply separately to this project.

The Contractor must list the State, its departments, divisions, agencies, offices, commissions, officers, employees, and agents as ADDITIONAL INSUREDS on the Commercial General Liability policy.

- (b) Vehicle Liability Insurance for bodily injury and property damage as required by law on any auto including owned, hired, and non-owned vehicles used in the Contractor's business.

The Contractor must list the State, its departments, divisions, agencies, offices, commissions, officers, employers, and agents as ADDITIONAL INSUREDS on the vehicle liability policy.

- (c) Worker's disability compensation, disability benefit or other similar employee benefit act with minimum statutory limits.

NOTE:

- (i) If coverage is provided by a State fund or if Contractor has qualified as a self-insurer, separate certification must be furnished that coverage is in the state fund or that Contractor has approval to be a self-insurer.
- (ii) Any citing of a policy of insurance must include a listing of the States where that policy's coverage is applicable; and
- (iii) This provision must not be applicable where prohibited or limited by Michigan law.

- (d) Employer's Liability Insurance with the following minimum limits:

\$1,000,000 each accident
\$1,000,000 each employee by disease
\$1,000,000 aggregate disease

(e) Pollution Liability Insurance in the amounts of not less than \$1,000,000 per occurrence is required.

3.3 **Liability Insurance:** Liability insurance must be endorsed to list as additional insureds the Professional's consultants and agents. Worker's Compensation, Employer's Liability Insurance and all other liability insurance policies must be endorsed to include a waiver of rights to recover from the Owner, Professional and the other additional insureds. The Contractor's liability insurance must remain in effect through the Correction Period and through any special correction periods. For any employee of the Contractor who is resident of and hired in Michigan, the Contractor must have insurance for benefits payable under Michigan's Worker's Compensation Law. For any other employee protected by Worker's Compensation Laws of any other state, the Contractor must have insurance or participate in a mandatory state fund, where applicable, to cover the benefits payable to any such employee. These requirements must not be construed to limit the liability of the Contractor or its insurers. The Owner does not represent that the specified coverage or limits of insurance are sufficient to protect the Contractor's interests or liabilities.

3.4 **Builder's Risk Insurance:** Unless indicated otherwise in the bid document, the Contractor will purchase and maintain property insurance for 100% of actual cash replacement value of the insurable Work while in the course of construction, including foundations, additions, attachments, and all fixtures, machinery and equipment belonging to and constituting a permanent part of the building structures. The property insurance also will cover temporary structures, materials and supplies to be used in completing the Work, only while on the building site premises or within five hundred feet of the site. The property insurance insures the interests of the Owner, Contractor and all Subcontractors and Suppliers at any tier as their interest may appear. The property insurance insures against "all risk" of physical loss or damage to the extent usually provided in policy forms of insurers authorized to transact this insurance in Michigan. A copy of the master insurance policy will be available for review by the State, upon request. Any deductible shall be both the option and responsibility of the **Contractor**.

3.5 The Owner and Contractor intend that the required policies of property insurance must protect all the parties insured and provide primary coverage for all losses and damages caused by the perils covered. Accordingly, to the extent that the insurance company pays claims, the Owner and the Contractor and its Subcontractors/Suppliers waive all rights against each other for any such losses and damages and waive all such rights against the Professional and all other persons named as insureds or additional insureds.

4. Prosecutions; Substantial Completion:

4.1 The Contractor must not start the Work at the site before the first day established by the Notice to Proceed and/or before all insurance is in effect. A pre-construction conference will be held with the Contractor to review its Progress Schedule, qualifications of its key personnel, its proposed access to the site, traffic and parking, procedures for submittal, change orders, etc., and to exchange emergency contact information. The Contractor must use its accepted Progress Schedule when making proposals or claims for adjustment in Contract Time/Price.

4.2 Except in an Emergency, all Work at the site must take place during normal working hours; 6:00 AM to 6:00 PM, during Business Days and in accordance with the special working conditions for the Agency. If the Contract Documents allow work outside the normal hours, the Contractor must provide a written notice to the Owner twenty-four hours before performing such Work and must reimburse the Owner any related increase in the costs incurred by the Owner such as overtime charges of the Professional and payments for custodial and security personnel.

4.3 If, upon inspection and completion of all pre-requisite testing of the Work, the Contractor considers that a portion of the work or all the Work is substantially completed, it must provide a list of items to be corrected or completed to the Owner and the Professional for joint inspection. Within ten Calendar Days of this joint inspection, the Professional will deliver to the Owner and Contractor a list of incomplete/Defective work or a Certificate of Substantial Completion with a Punch List. The certificate must:

- fix a reasonable date of Substantial Completion,
- fix a date for completion of the Punch List, and
- recommend the division of responsibilities between the Owner and Contractor for utilities, security, safety, insurance, maintenance, etc.

Upon issuing the Certificate of Substantial Completion, the Owner will pay for the completed Work subject to (a) withholding of two hundred percent of the value of any uncompleted Work, as determined by the Professional, and (b) any other deductions as the Professional may recommend or may withhold to cover Defective work, liquidated damages and the fair value of any other items entitling the Owner to a withholding. Prerequisites for Substantial Completion, over and above the extent of Work completion required, include (a) receipt by the **Owner** of operating and maintenance documentation, (b) all systems have been successfully tested and demonstrated by the **Contractor** for their intended use, and (c) the **Owner** having received all required certifications and/or occupancy approvals from the State and those Political Subdivisions having jurisdiction over the Work. Receipt of all certifications and/or occupancy approvals from those Political Subdivisions with jurisdiction in and of itself does not necessarily connote Substantial Completion. The Contractor must provide all related operating and maintenance (O&M) documentation to the Owner before training if training is required and not later than Substantial Completion otherwise. The Contractor must give the Owner the final O&M documentation (with revisions made after Substantial Completion) before the request for final payment.

4.4 The Owner may decide to use, at its sole option, any functioning portion of the Work and will inform the Contractor in writing of the decision. The portion of Work to be used must be jointly inspected to determine the extent of completion if it has not undergone the inspection for Substantial Completion. The Professional must prepare a list of items to be corrected/completed and the Owner will allow the Contractor reasonable access to correct/complete the listed items and finish other work.

5. Warranty; Tests, Inspections and Approvals; Corrections of Work:

5.1 **Warranty:** The Contractor must furnish the State with a written guarantee to remedy any defects due to faulty materials or labor which appear in the Work within one year from the date of final acceptance by the State. This warranty excludes defect or damage caused by (a) abuse, modification by others, insufficient or improper operation or maintenance, or (b) normal wear and tear under normal usage. Manufacturer warranties for materials and equipment received by the Contractor must be assigned and promptly delivered to the Owner at Substantial Completion. The warranties period starts from the date of the substantial completion and must be in full force and effect for the entire duration of the Correction Period.

Roof Warranty: For roofing systems, the following warranties are required as minimum:

- (a) A two-year contractor's warranty against any defects due to faulty materials or labor.
- (b) A fifteen-year manufacturer's total system warranty; and
- (c) A twenty-year membrane/shingles/tiles warranty.

5.2 **Tests, Inspections and Approvals:** The Owner will perform or retain a professional/agency to perform inspections, tests or approvals for those materials required to meet quality control standards specified in the Contract Documents except for those inspections, tests or approvals specifically designated to the Contractor in the Contract Documents. However, the Contractor must assume full responsibility for any testing, inspection, or approval

- (a) required to meet code requirements, as promulgated by code inspecting authorities.
- (b) required by Law.
- (c) indicated or required by the Contract Documents as designated to the Contractor.
- (d) required for the Professional's acceptance of a Supplier, materials or equipment or mix designs submitted for prior approval by the Contractor; or
- (e) Defective work, including an appropriate portion of the Delay and costs occasioned by discovery of Defective work. The Contractor must (a) pay all related costs; (b) schedule related activities; and (c) secure and furnish to the Professional the required certificates of inspection, testing or approval. The Contractor must provide proper and safe access to the site for inspection, testing or approval. The Contractor must provide the Professional a timely notice whenever any Work is ready for inspection, testing or approval. If the Contractor covers any Work without proper approval by the Professional as required by the Contract Documents, the Contractor must, at its own expense, uncover, expose, or otherwise make available, when requested by the Professional or Owner, for testing, inspection, or approval of the covered Work.

5.3 **Correction of Work:** If any testing, inspection, or approval reveals Defective Work and the Work is rejected by the Professional, the Contractor, at its sole expense, must promptly, as directed, correct, or remove the Defective Work from the site and replace it with non-Defective Work within the Correction Period. The Contractor must bear responsibility for its proportionate share of the Delay and costs resulting from the correction and/or removal and replacement of Defective Work. If the Contractor, within reasonable and agreed upon time after receipt of written notice, (a) fails to correct Defective Work or remove and replace rejected Work, or (b) fails to correct or complete items on any Punch List, or (c) fails to perform Work in accordance with the Contract Documents, or (d) fails to comply with any other provision of the Contract Documents, the Owner, directly or through others, after seven Calendar Days from the date of the written notice to the Contractor, may correct and remedy the Defective Work. To the extent necessary to correct and remedy such Defective Work, the Owner must be allowed to exclude the Contractor from all or part of the site; take possession of all or part of the Work and stop related operations of the Contractor; take possession of the Contractor's tools, plant and office and construction equipment at the site; and incorporate into the Work materials and equipment for which the Owner has paid the Contractor. The Contractor must allow the Owner and the Professional easy access to the site to correct such Defective Work. The Owner must be entitled to an appropriate decrease in Contract Price for all claims, costs, losses, damages, and Delay incurred or sustained by the Owner which are attributable to the Contractor. Such costs may include, but not limited to, costs of correction or removal and replacement of Defective Work, costs of repair and replacement of other work destroyed or damaged by the action and related charges of the Professional. If the discovery of the Defective Work takes place after final payment and the Contractor fails to correct and pay the Owner any of these costs, the Owner must demand due performance under the Performance Bond. Until the period of limitation provided by Michigan Law, the Contractor must promptly, and upon receipt of written notice from the Owner, correct Defective Work. In the event of an Emergency or unacceptable risk of loss or damage or if appropriate under the circumstances, the Owner, directly or through others under contract with the Owner, may correct or remove and replace the Defective Work. The specified correction of Work requirements has no limitation on the rights of the Owner to have Defective Work corrected or removed and replaced, if rejected, except as otherwise provided by the Michigan Law.

5.4 **Special Correction Period Requirements:** Whenever the Owner undertakes any portion of the Work because the Contractor's act or omission Delays completion of the Work or it is eligible for Partial Use, the warranties for all materials and equipment incorporated into that portion of the Work must remain in full force and effect between the start of such Partial Use and the date when the Correction Period starts. The Correction Period for any Defective Work that is corrected or rejected and replaced within

the last three months of the Correction Period must be extended by an additional six months, starting on the date such Work was made non-Defective.

5.5 Special Maintenance Requirements: If the Contract Documents specify that the entire Work, or a portion of the Work, upon reaching Substantial Completion, must not be placed in use by the Owner, the Contractor must maintain the Work, or specified part of the Work, in good order and proper working condition and must take all other actions necessary for its protection between the certified date of Substantial Completion and the date when the Work, or designated part of the Work, is placed in use. If no separate price for such special maintenance period was requested and made part of the Contract Documents, the Owner will amend the Contract Documents to appropriately increase the Contract Price.

6. Changes:

6.1 Changes in the Work: The Owner may, at any time, without notice to sureties, make any changes bilaterally or unilaterally, by a written Change Order, in the Work within the general scope of the Contract, including but not limited to changes in the Specifications, materials, or Contract Time. In a bilateral change order, the Owner may direct the Professional to prepare a Bulletin describing the change being considered. Upon receiving the Bulletin, the Contractor establishes the cost and returns it to the Professional for review within 15 calendar days. The Contractor's proposal must be irrevocable for 60 Calendar Days after it is submitted to the Professional. If the Professional recommends acceptance of the Bulletin and the Owner agrees with the changes, the Owner issues a written bilateral Contract Change Order to amend the Contract Documents. However, the Owner may issue a unilateral Change Order if the Owner and Contractor are unable to agree on the adjustment in Contract Price or Time. If the Contractor disagrees with such unilateral Contract Change Order, the Contractor must complete the Work and may deliver notice of a claim in accordance with the claim submittal process.

6.2 Differing Site Condition: The Owner does not warrant that any technical data, including the Project reference points, provided by the Owner is necessarily sufficient and complete for the purpose of selecting Means and Methods, initiating, maintaining, and supervising safety precautions and programs or discharging any other obligation assumed by the Contractor under the Contract Documents. If different or unknown site conditions are discovered, the Contractor must notify the Owner in writing before the conditions are disturbed or before proceeding with the affected Work. Upon review, if the Owner decides to agree with the differing site conditions, with the Professional's advice, the Owner may issue a written Contract Change Order to amend the Contract Price or Time through the Bulletin authorization process. If the Owner decides to disagree with the Contractor and the Contractor disagrees with the Owner's decision, the Contractor must complete the Work and may deliver notice of a claim in accordance with the claim submittal process. No proposal or claim by the Contractor due to differing site conditions will be allowed (a) if the Contractor knew of their existence before submitting its Bid or if those conditions could have been discovered by any reasonable examinations for which the Contractor, as Bidder, was made responsible under the Bidding Requirements and/or (b) unless the Contractor's written notice is provided within not more than 21 days after the contractor first recognizes the condition giving rise to the proposal or claim and gives the Owner adequate opportunity to investigate the asserted differing site conditions. A full and detailed breakdown of cost and time requested, with supporting documentation, if not provided with the initial notice shall be delivered to the Professional and Owner within 15 days of the notice, unless otherwise agreed in writing, by the Owner prior to expiration of such time.

6.3 Responsibilities for Underground Utilities: The Contractor must comply with the 1974 PA 53, as amended, MCL 460.701 et seq. and all other Laws concerning Underground Utilities. Before performing site Work, all Underground Utilities, lines, and cables (public and private) must be located and marked. The Contractor must notify MISS DIG to locate and mark utilities on properties that are not State properties. In addition, the Contractor must be responsible for immediately notifying the Owner of any contact with or damage to Underground Utilities, and for the safety, protection of and repairing any damage done to any Work, surface, and subsurface facilities. If the Contractor encounters Underground Utilities that inaccurately located by the Contract Documents or not previously located/located, which could not be reasonably have been seen, the Owner may issue a written Contract Change Order to amend the Contract Price or Time through the Bulletin authorization process.

6.4 Hazardous Material Conditions: If the Contractor encounters material reasonably believed to be Hazardous Material, which was not described in the Drawings and/or Specifications and was not generated or brought to the site by the Contractor, the Contractor shall immediately stop all affected work, give written notice to the Owner of the conditions encountered, and take appropriate health and safety precautions in accordance with all federal, state, and local laws. Upon receipt of the notice, the Owner will investigate the conditions and (a) may stop the Work and terminate the affected Work or the Contract for convenience; (b) may contract others to have the Hazardous Material removed or rendered harmless or (c) issue a written Contract Change Order to amend the Contract Price/Time through the Bulletin authorization process. If the Hazardous Material is brought to site by the Contractor or as a result in whole or in part from any of its violation of any Law covering the use, handling, storage, disposal of, processing, transport and transfer or from any other act or omission within its control, the Contractor is responsible for the Delay and costs to clean up the site, remove and render harmless the Hazardous Material to the satisfaction of the Owner, State and all Political Subdivisions with jurisdiction.

6.5 Incidents with Archaeological Features: The Contractor must immediately notify the Owner in writing of any Archeological Feature deposits encountered at the site and must protect the deposits in a satisfactory manner. If the Contractor encounters such features, which result in an anticipated change to the Contract Price/Time, the Owner may issue a written Contract Change Order through the Bulletin authorization process.

6.6 Unit Price Work: Quantities as listed have been carefully estimated but are not guaranteed. The Owner reserves the right to increase or decrease the quantities of the Work to be performed at the Unit Price by amounts up to 20 percent of the listed estimated quantities. For Unit Price Work, the Contractor must promptly inform the Professional in writing if actual quantities differ from the estimated quantities for any item. For quantities over 120% or below 80% of the estimated quantity, the Owner may negotiate a Unit Price with the Contractor, or direct a unilateral change, or bid that Work under separate contract. Any adjusted Unit Price agreed upon by the Owner will only apply to the actual quantities above 120% or below 80% of the estimated quantity. No adjustment due to quantity variations must be allowed (a) unless the Contractor met the notice requirements, or (b) if any Unit Price increase results in whole or in part from any act or omission within the control of the Contractor (errors in the Contractor's Bid, unbalanced Unit Prices, etc.). If a dispute arises between the Owner and the Contractor on the adjusted Unit Price, the Contractor must carry on the Work with due diligence during the disputes/disagreements.

6.7 Cash Allowances; Provisionary Allowances: The Contractor must obtain the Professional's and Project Director's written acceptance before providing materials, equipment, or other items covered by Cash Allowance. Work authorized under any Provisionary Allowance may consist of (a) changes required by actual conditions, as determined by the **Professional**, and (b) any other Work authorized and completed under the pertinent provisions of the Contract Documents.

6.8 Changes in Contract Price:

- 6.8.1 The Contractor's proposals or claims for Work Involved must detail all affected items of Work, whether increased, revised, added, or deleted, and must be fully documented and itemized as to (a) individual adds and deducts in Work quantities and labor man-hours; (b) corresponding itemized cost of Work Involved; (c) materials and equipment cost including transportation, storage, and suppliers' field services; and (d) Fee.
- 6.8.1.1 No proposal or claim by the Contractor on account of any asserted change not issued as a Bulletin by the PSC or Owner, shall be allowed unless initiated by written notice of such proposal or claim to the Professional and Owner within 21 days after the occurrence of the event giving rise to the proposal or claim. A full and detailed breakdown of cost and time requested, with supporting documentation, if not provided with the initial notice shall be delivered to the Professional and Owner within 15 days of the notice, unless otherwise agreed in writing, by the Owner prior to expiration of such time.
- 6.8.2 For Contractor's proposals or claims for adjustments in Contract Price arising from Delays, the Contractor's estimates must be as comprehensive and detailed as may be appropriate to support the proposal or claim. Examples of related information include labor manpower levels, production data and Progress Schedule revision.
- 6.8.3 If the Contract Documents use lump sum or Unit Prices for the Work Involved, those prices must be used in estimating the price change. Otherwise, the Owner may direct the Contractor to proceed (a) on a negotiated lump sum; or (b) on an actual cost basis with or without a guaranteed maximum; or (c) through a unilateral Change Order on a lump sum basis or a not-to-exceed basis, based on the Professional's estimate of the anticipated Cost of the Work Involved and a fee. Items making-up the Cost of the Work Involved must be allowable to the extent (a) consistent with those prevailing in the Project locality, (b) necessary, reasonable, and clearly allocable to the Work Involved, and (c) limited to labor costs, subcontract costs, material and equipment costs, construction equipment costs and general conditions costs.
- 6.8.4 In estimating any additional cost by the Contractor or its Subcontractor, the rates for the craft labor man-hour used in estimating changes in Contract Price must not exceed the rates in Means Cost Data (Means) or other cost guide acceptable to the Owner. If the rates exceed the acceptable cost guides, the Contractor must provide proper justifications acceptable to the Professional and the Owner. The payroll costs may be used to quote a Bulletin. However, the payroll costs must include wages, labor burdens and a factor for field supplies and purchase costs (less market values if not consumed) of tools not owned by the workers. Labor burdens must be certified by an authorized financial representative of the Contractor and may include social security, unemployment, taxes, workers' compensation, health and retirement benefits, vacation, and holiday pay. The factor for field supplies and tools (individually valued at less than \$1,000.00) must not exceed 4% of the wages without burdens, unless detailed data, which supports higher costs, is provided. Rates for owned, rented, or leased construction equipment must be in accordance with the contract price rates. Otherwise, the appropriate hourly, daily, weekly, or monthly rates listed in Means must be used. However, if the total rental or lease cost of an item to the Project exceeds the reasonable purchase price of the rented or leased item, the Owner reserves the right to pay only the purchase price of the item and take title to the item. Operating cost must not exceed the hourly operating rate in Means and for multiple shifts, rates must not exceed the shift work adjustments recommended in the cost guide.
- 6.8.5 The cost of any Work Involved may include necessary general conditions costs to the extent those costs increase or decrease on account of, or are directly attributable to, the performance of the furnishing and/or performance of the additional Work Involved or are required due to an extension in Contract Times or Delays. Such costs may include payroll costs of personnel, temporary facilities at the site, liability insurance and bond premiums, Subcontractors, royalty payments and fees for permits and licenses and taxes on the Work Involved.
- 6.8.6 A contractor or subcontractor who performs the Work may charge a fee of up to 15% of the cost of Work involved for overhead and profit. Contractor may charge a mark-up fee of up to 5% of its Subcontractor's cost excluding fees if the Work is performed by the Subcontractor. If Work is to be performed by lower tier subcontractor(s), intermediate subcontractors and the Contractor must share a fee of up to 5% of the lowest tier subcontractor's cost excluding fees. The total mark-up fees for the Work must not exceed 20% of the lowest tier subcontractor's cost excluding fees. If the adjustment to the Contract Price incorporates a

contractor reservation of rights to claim additional adjustments, the fees must be reduced by one-third. Contractor's administrative costs and home office overhead must be non-reimbursable expenses covered by the Fee for the Work.

6.9 Changes in Contract Time:

- 6.9.1 If a justified extension beyond the Contract Time is not reasonably anticipatable under the circumstances, the Owner may approve an extension to the Contract Time through the Bulletin authorization process at no additional cost to the Owner. Examples of events that may justify an extension in the Contract Time include acts of God; acts of the public enemy; fires; floods; and strikes.
- 6.9.2 If, at any time during the life of this Contract, the Contractor finds that for reasons beyond its control, it will be impossible to complete the Work on or before the Contract completion date, a written request for a change to the Contract extending the time of completion must be submitted. Such a request must set forth in precise detail the reasons believed to justify an extension and must be in such format as the State may require.
- 6.9.3 When submitting a quotation for a Contract change authorization for extra work or change in plans, the Contractor must include as part of the quotation, a statement requesting any extra time necessary to complete the related Work. Lack of such a statement will serve as notification that the extra time will not be required to complete the Contract work and will waive the right to a later claim. The Owner will not pay additional compensation to the Contractor for performing Contract Work during any extension period granted.
- 6.9.4 If the Progress Schedule and the funding allow for an early completion date, the Contractor may submit to the Owner for approval, a request to shorten the Contract Time. If approved by the Owner, the new Contract Time applies to the Project and liquidated damages, if any, will be assessed for any delays after the new completion date.

6.10 Price Reduction for Defective Cost or Pricing Data: Whenever the Contractor signs a proposal for a change in the Contract or claim settlement, the Contractor will be deemed to have certified on behalf of itself, Subcontractors and Suppliers, to its best knowledge and belief that the proposal and its contents (a) were made in good faith and are consistent with the facts and the provisions of the Contract; and (b) are current, complete, and accurate. If the Contract Price/Time is increased by any Change Order, claim or dispute settlement because the Contractor, Subcontractor or Supplier, at any tier, represented or furnished cost or pricing data of any kind that were false, contained math errors or were incomplete, the Contract Price must be correspondingly reduced by Change Order. If there is a good cause to doubt the Contractor's compliance with the Defective cost and pricing data requirements, the Owner must be entitled to make an appropriate withholding from any payment otherwise owed to the Contractor.

7. Payments

- 7.1 **Schedule of Values:** The Schedule of Values must be approved by the Professional and accepted by the Owner and must divide the Work into pay items for significant Sections and areas, facilities, or structures, with subtotals for first tier Subcontractors. As required or as noted in Division 1, the accepted Schedule of Values must be supported by a more detailed breakdown allocating the pay items to the Progress Schedule Activities. It must tabulate labor costs, Subcontract costs and material and equipment costs. Labor costs must include appropriate sums for construction equipment costs, general conditions costs, administrative costs, and profit, unless separate pay items are itemized for those costs. The Schedule of Values must include two percent of the Contract Price for each of the following close-out pay items: (a) fire safety inspection, certificate of occupancy and other code approvals, as specified in the Contract Documents, (b) manufacturer warranties, finalized operating and maintenance documentation, Owner training documentation, and test and balance reports, and (c) finalized as built/Record Documents.
- 7.2 **Requests for Payment:** Not more than once every thirty Calendar Days, the Contractor may submit to the Professional a Request for Payment on the Owner's form signed by the Contractor certifying Work completed and enclosing all supporting documentation. A draft copy of the payment request must be submitted to the Owner Field Representative for review and comments. For projects under \$50,000, the Contractor may not submit more than two requests in addition to the final payment request. Each Request for Payment must certify that all monies owed by the Contractor to Subcontractors and Suppliers for which payment previously has been sought has been paid from payments received and include a sworn statement. No Request for Payment must include amounts for a Subcontractor or Supplier if the Contractor does not intend to use the payments requested, when received, to reduce the Contractor's outstanding obligations on the Work. The Owner will pay the Contractor within thirty Calendar Days after the Owner receives and approves a certified Request for Payment from the Professional. The Contractor will provide a certification in writing that the payment request submittal is true and accurate. If payment is requested based on materials and equipment stored at the site or at another location agreed to in writing, the Request for Payment also must be accompanied by (a) consent of surety, (b) a bill of sale, invoice or other documentation warranting that the Owner has received the materials and equipment free and clear of all liens, and (c) evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect them and the Owner's interests. The Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Request for Payment, whether incorporated in the Work or not, will pass to the Owner free and clear of all liens no later than at the time of payment by the Owner to the Contractor.

- 7.2.1 **Electronic Funds Transfer:** The State will only disburse payments under this Contract through Electronic Funds Transfer (EFT). Contractor must register with the State at <http://www.michigan.gov/SIGMAVSS> to receive electronic fund transfer payments. If Contractor does not register, the State is not liable for failure to provide payment. Without prejudice to any other right or remedy it may have, the State reserves the right to set off at any time any amount then due and owing to it by Contractor against any amount payable by the State to Contractor under this Contract.
- 7.3 **Review of Request for Payment; Intent of Review:** Within ten Calendar Days after receipt of a Request for Payment, the Professional must certify to the Owner the amount the Professional determines to be due or must return the Request for Payment to the Contractor indicating the reasons for withholding certification. The Professional's certification of any Request for Payment constitutes a representation to the Owner that the Work has progressed to the point indicated; that to the best of the Professional's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents; and that the Contractor is entitled to payment in the amount certified. In the case of final payment, the Professional's certification of final payment and recommendation that the Work is acceptable must be a further representation that conditions governing final payment to the Contractor have been met.
- 7.4 **Refusal to Make or to Recommend Payment:** The Owner may withhold from any payment an amount based on the (a) Professional's refusal to recommend payment or (b) Owner's estimate of the fair value of items included in the payment request. The Owner will give the Contractor reasonably prompt written notice supporting such action. The Professional may refuse to recommend any part of any payment, or because of subsequently discovered evidence, inspections or tests or the value of the Punch List, nullify all or any portion of any payment previously recommended, as the Professional may consider necessary to protect the Owner from loss because:
- (a) the Work is Defective or completed Work has been damaged requiring correction or replacement,
 - (b) the Contract Price has been reduced by Change Order,
 - (c) it has been necessary that the Owner correct Defective Work or complete Work,
 - (d) reasonable evidence exists that all or a part of the Work will not be completed within the corresponding Contract Time,
 - (e) the Contractor failed to comply with any material requirements of the Contract, including, but not limited to the failure to submit Progress Schedule Submittals or as built/Record Documents when due,
 - (f) stored materials for which payment has been made or is sought has been determined by the Professional or the Owner Field Representative to be damaged or missing, or
 - (g) the Professional reasonably believes or knows of the occurrence of an event justifying termination for cause.
- 7.5 **Request for Final Inspection:** The Contractor must complete the Substantial Completion Punch List within the Contract Time and date. The Contractor must assemble all required documentation before requesting final inspection in writing. The Contractor may request final inspection of the entire Work, or the part of the Work for which final payment is specified in the Contract Documents. Upon this written notice, and if deemed appropriate by the professional, the Professional will make a final completion inspection with the Owner and Contractor and notify the Contractor of all incomplete or Defective Work revealed by the Final Inspection. The Contractor must immediately correct and complete the Work.
- 7.6 **Close-out Documents:** The Contractor must prepare and submit the following documentation before requesting final inspection or final payment: final operating and maintenance documentation (with revisions made after Substantial Completion), warranties, inspection certificates, as built/Record Documents, release of payment claim forms, and all other required documents.
- 7.7 **Request for Final Payment:** The Contractor may request final payment after correcting or completing the Work to the satisfaction of the Professional and delivering close-out documentation (7.6). The Contractor's request for final payment must also enclose:
- (a) evidence of completed operations insurance and an affidavit certifying that the insurance coverage will not be canceled, materially changed, or renewal refused,
 - (b) an affidavit certifying that the surety agrees that final payment does not relieve the surety of any of its obligations under the Performance Bond and Payment Bond,
 - (c) a completed DTMB-0460 Form close out checklist,
 - (d) a list of all pending insurance claims arising out of or resulting from the Work being handled by the Contractor and/or its insurer
 - (e) Contractor's 'Guarantee and Statement' (DTMB-0437) containing a statement of guaranteed indebtedness acceptable to the Owner in the full amount of the Contract Price, or a release of payment claims in the form of a release of liens, or a Bond or other security acceptable to the Owner to indemnify the Owner against any payment claim.
- 7.8 **Final Payment and Acceptance:** If the Professional is satisfied that the entire Work, or the part of the Work for which final payment is specified in the Contract Documents, is complete and the Contractor's other obligations under the Contract Documents has been fulfilled, the Professional will furnish to the Owner and Contractor the Professional's certification of final payment and acceptance within thirty Calendar Days after receipt of the final payment request. If the Professional is not satisfied, the Professional will return the request to the Contractor indicating in writing the reasons for not certifying final payment. If the final payment request is returned, the Contractor must correct the deficiencies and re-request final payment. If the Owner concurs with the Professional's certification of final payment the Owner will, within thirty Calendar Days after receipt of the Professional's certification of final payment, pay the balance of the Contract Price subject to those provisions governing

final payment specified in the Contract Documents. If the Owner does not concur with the Professional's determination, the Owner will return the request for final payment to the Contractor with written reasons for refusing final payment and acceptance.

7.9 Contractor's Continuing Obligation: The following does not constitute acceptance of the Work in the event the Work or any Work is not in accordance with the Contract Documents, and therefore does not release the Contractor from its obligation to perform and furnish the Work in accordance with the Contract Documents:

- (a) a certification by the Professional of any Request for Payment or final payment.
- (b) the issuance of a Substantial Completion certificate.
- (c) any payment by the Owner to the Contractor.
- (d) any Partial Use.
- (e) any act of acceptance by the Owner or any failure to do so.
- (f) any review and approval of a Shop Drawing, sample, test procedure or other Submittal.
- (g) any review of a Progress Schedule.
- (h) any On-Site Inspection.
- (i) any inspection, test, or approval.
- (j) any issuance of a notice of acceptability by the Professional; or
- (k) any correction of Defective Work or any completion of Work by the Owner.

7.10 Waiver of Claims: The making of final payment does not constitute a waiver by the Owner of any rights as to the Contractor's continuing obligations under the Contract Documents, nor will it constitute a waiver of any claims by the Owner against the Contractor still unsettled, or arising from unsettled payment claims, Defective Work appearing after final inspection or failure by the Contractor to comply with the Contract Documents or the terms of any special warranties provided by the Contract Documents or by Law. The acceptance of final payment will constitute a waiver of all claims by the Contractor against the Owner, other than those claims previously made in writing, on a timely basis.

8. Other Work: During the Contract Time, the Owner may self-perform or Contract for other work at the site. By doing so, the Owner or its representative will coordinate the operations of the Contractor and the other work. Whenever the other work interfaces with the Contractor's Work on site, the Contractor must coordinate its activities with the interfacing work, inspect the other work and promptly report to the Professional in writing if the other work is unavailable or unsuitable. The Contractor's failure to do so will constitute an acceptance of such other work as fit and proper for integration with the Work except for latent or non-apparent defects and deficiencies in the other work. The Contractor must provide proper and safe access to the site for handling, unloading and storage of their materials and equipment and for the execution of the other work. The Contractor must do all cutting, fitting, patching, and interfacing of the Work that may be required to make any part of the Work come together properly and integrate with other work. If the Contractor becomes party to a dispute or claim due to damages caused to its Work/property or other work/their property, the Contractor must promptly attempt, without involving the Owner or the Professional or their agents, to settle with the other party by agreement or otherwise resolve the claim. If the Owner determines that the other work resulted in a delay to the Work to be performed by the Contractor and such delay justifies a Change Order, the Owner will authorize the necessary adjustment in Contract Price and/or Time.

9. Stop Work Orders and Suspension of Work: The Owner may order the Contractor in writing to defer, stop, suspend, or interrupt all or part of the Work, in the event any of the following situations:

- (a) any Work is Defective,
- (b) any Work, when completed, will not conform to the Contract Documents,
- (c) any materials or equipment are unsuitable,
- (d) any workers are insufficiently skilled,
- (e) failure of the Contractor to implement appropriate measures for the SESC, or
- (f) as the Owner may determine appropriate for its convenience. The Contractor is responsible for the Delays and any additional costs if at fault. Any justified increase in Contract Price/Time due to suspension of Work must be submitted within twenty-one Calendar Days of knowing the extent of Delays and before submitting the final payment.

10. Termination:

10.1 Termination for Breach: The Owner may elect to terminate all or any part of the Work if:

- (a) the Contractor fails to complete the Work, or a specified part of the Work, within the corresponding Contract Time; fails or refuses to supply sufficient management, supervision, workers, materials, or equipment; or otherwise fails to prosecute the Work, or any specified part of the Work, with the diligence required to comply with the Contract Time(s).
- (b) the Contractor persistently disregards the authority of the Professional or violates or disregards a provision of the Contract Documents or the Laws of any Political Subdivision with jurisdiction.
- (c) the Contractor admits in writing, or the Owner otherwise establishes, the Contractor's inability or refusal to pay the Contractor's debts generally as they become due.
- (d) in response to the Owner's demand, the Contractor fails to provide adequate, written assurance that the Contractor has the financial resources necessary to complete the Work within the Contract Time.

- (e) the Contractor fails to comply with the Michigan Residency requirements (1984 PA 431, as amended, MCL 18.1241a); or is found to be in violation of Section 4 of 1980 PA 278 concerning unfair labor practices, or any nondiscrimination requirements imposed by Law.
- (f) at any time, the Contractor, Subcontractor or Supplier is in violation of unfair labor practices prohibited by Section 8 of Chapter 327 of the National Labor Relations Act, 29 U.S.C. 158; or
- (g) the Contractor violates or breaches any material provision of the Contract Documents, which provides contractually for cause termination or rescission of the Contract or of the Contractor's right to complete the Work.

Within seven Calendar Days after the Contractor receives a notice requiring assurance of due performance for any of the above occurring non-conformances, the Contractor must meet with the Owner and present the Contractor's plan to correct the problems. If the Owner determines that the Contractor's plan provides adequate assurance of correction, that determination does not waive the Owner's right to subsequently default the Contractor or affect any rights or remedies of the Owner against the Contractor and/or surety then existing or that may accrue in the future. The Owner, after giving the Contractor and surety seven Calendar Days' written notice of intent to default, may declare the Contractor in default and terminate the services of the Contractor for cause. Unless otherwise agreed between the Owner and Contractor, at the expiration of the Seven-Calendar Day (intent to default) period, the Contractor must immediately stop all Work and proceed in accordance with the Owner's instructions. Following the expiration of the Seven-Calendar Day (intent to default) notice, the Contractor will be sent a default letter – notice of termination for cause. The Owner will issue a Contract Change Order to revise the name of the contract party to the name of the surety company. The surety company must undertake to perform and complete the Work, in accordance with the Contract Documents, in place of the Contractor, either through the surety's agents or by executing agreements with qualified contractors (excluding the Contractor and any of the Contractor's affiliates), or both.

The Owner may issue a fifteen-Calendar Day notice of intent to default the surety company if they fail to execute in a timely manner the completion of the Contract Work. Without an adequate plan of correction, the Owner may issue a notice of termination for cause letter to the surety. If a termination of the contract with the surety occurs, the Owner reserves the right to complete the Work.

If the Owner has terminated the Contractor, any such termination will not affect any rights or remedies of the Owner against the Contractor or surety, or both, then existing or that may accrue after termination. All provisions of the Contract Documents that, by their nature, survive final acceptance of the Work must remain in full force and effect after a termination for cause of the Contractor or default of the surety, or both. The Owner may, in its sole discretion, permit the Contractor to continue to perform Work when the Contractor is in default or has been defaulted. Such decision by the Owner in no way operates as a waiver of any of the Owner's rights under the Contract Documents or Performance Bond, nor in the event of a subsequent default, entitle the Contractor or surety to continue to perform or prosecute the Work to completion.

- 10.2 **Termination on Non-Bonded Project:** For non-bonded projects, the Owner will follow the termination protocol in Paragraph 10.1 without involving a surety.
- 10.3 **Termination for Convenience of the Owner:** Upon fifteen Calendar Days' written notice to the Contractor and surety, or sooner if reasonable under the circumstances, the Owner may, without cause and without prejudice to any other right or remedy it may have, elect to terminate any part of the Work, or the Contract in whole or in part, as the Owner may deem appropriate for its convenience. Upon receipt of any such termination notice, the Contractor must immediately proceed in accordance with any specific instructions, protect and maintain the Work, and make reasonable and diligent efforts to mitigate costs associated with the termination. In such termination, the Contractor must be paid in accordance with the terms of this Contract for only services rendered before the effective date of termination. Upon termination for convenience, the Contractor must be released from any obligation to provide further services and the Owner must have full power and authority to take possession of the Work, assume any agreements with Subcontractors and Suppliers that the Owner selects, and prosecute the Work to completion by Contract or as the Owner may deem expedient.
- 10.4 **Termination for Lack of Funding:** If expected or actual funding is withdrawn, reduced, or limited in any way before the completion date set forth in this Contract or in any amendment, the State may, upon written notice to the Contractor, terminate this Contract in whole or in part in accordance with Paragraph 10.3.
11. **Disputes:** All claims, counterclaims, disputes, and other matters in question between the Owner and Contractor arising out of or relating to the Contract Documents must be submitted in writing to the Professional and otherwise processed and resolved as provided in this Article. *Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Initial Decision Maker (Professional/PSC). Claims by either party must be initiated within 21 days after the occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognized the condition giving rise to the claim. Provided such timely notice is delivered, a full and detailed breakdown of cost and time requested, with supporting documentation, if not provided with initial notice shall be delivered to Professional and Owner within 15 days of the notice, unless otherwise agreed in writing, by the Owner prior to expiration of such time.* The Contractor must carry on the Work with due diligence during all disputes or disagreements. Work must not be delayed or postponed pending resolution of any disputes or disagreements. The Contractor must exercise reasonable precautions, efforts, and measures to avoid situations that would cause delay.
- 11.1 **Notice of Claim:** Except for Owner claims for liquidated damages, no claim is valid unless it is based upon written notice delivered by the claimant to the other party and the Professional/PSC within 21 days of the event giving rise to the claim. The

notice must state the nature of the dispute, the amount involved, if any, and the remedy sought. The claim submittal with all supporting data must be delivered within thirty (30) Calendar Days after the initial notice unless the Professional allows an extension by written approval. A claim by the Contractor must be submitted to the Professional and Project Director for a recommendation or decision from the Professional. A claim by the Owner must be submitted to the Contractor and the Professional for a written recommendation or decision by the Professional. The Owner reserves the right to audit any Contractor claim (or claim package) that the Contractor values at more than \$50,000.00. Pending final resolution of any claim under this Article, the Contractor must proceed diligently with the Work and comply with any decision of the Owner and/or Professional. For all Contractor claims seeking an increase in Contract Price or Contract Time, the Contractor must submit an affidavit, certifying that the amount claimed accurately reflects any Delay and all costs that the Contractor is entitled from the occurrence of the claimed event and that supporting cost and pricing data are current, accurate, complete and represent the Contractor's best knowledge and belief. The affidavit must be signed in the same manner as required in Item 6 of Section 00100.

- 11.2 Recommendations or Decisions from the Professional:** For claims under \$100,000.00, if requested in writing by the Contractor, the Professional will render a recommendation or decision within thirty Calendar Days after the request and the Owner will issue, if necessary, a determination within thirty Calendar Days after the Professional's recommendation or decision. For claims exceeding \$100,000.00, the Professional will issue its recommendation or decision and the Owner, if necessary, will issue its determination, within sixty Calendar Day.

If the Professional denies a Contractor claim or agrees with an Owner claim, that decision must be final and binding on the Contractor, without any determination by the Owner, unless the Contractor files a request for a presentation with the Director-DCD within thirty Calendar Days. To the extent that any recommendation from the Professional is partly or wholly adverse to a claim from the Owner, that determination must be final and binding on both the Owner and Contractor unless either party files a request for a presentation with the Director-DCD within thirty Calendar Days. If the Professional recommends payment of any Contractor claim which increases the Contract Price, that recommendation is subject to the Owner's written approval. In the event any such determination from the Owner is partly or wholly adverse to the preceding recommendation from the Professional, that determination must be final and binding on the Contractor unless the Contractor files suit in the Michigan Court of Claims within thirty Calendar Days after receipt of such determination. The claim is waived if not made in accordance with these requirements.

If either the Contractor or Owner is not satisfied with any decision of the Professional on a claim, that party must, within thirty Calendar Days of receiving that decision, file a written appeal with complete supporting documentation with the Director-DCD. The Director-DCD has discretion concerning the allowability of evidence submitted and is not bound to any rules of evidence. If the right to a presentation is waived or if a presentation is conducted and the dispute remains unresolved, the Director-DCD, at the Director-DCD's sole option, must specify in which forum the dispute must be conducted by issuing a written determination to the Contractor that the dispute if the Contractor so elects, be submitted in writing to the Michigan Court of Claims. The Director-DCD's determination on the dispute is final and binding on the Contractor unless the Contractor files a lawful action in the Michigan Court of Claims within thirty Calendar Days after receiving the Director-DCD's determination. After settlement or final adjudication of any claim, if payment by the Contractor is not made to the Owner, the Owner may offset the appropriate amounts against (a) payments due to the Contractor under any other Contract between the Owner and the Contractor, or (b) any amounts for which the Owner may be obligated to the Contractor in any capacity. The Director-DCD may designate someone to fulfill the Director-DCD's duties under these terms and conditions.

END OF SECTION 00700

SECTION 00750 SPECIAL WORKING CONDITIONS

1. The Work is for the Department of Military and Veterans Affairs and their special working conditions are included in Appendix II. Contractor must comply with all security regulations. Access to and egress from the buildings and State Agency grounds must be via routes specifically designated by the State Agency. Whenever the Contractor has caused an operating security or fire system to go out of service or left unsecured openings in existing facilities or security fences, the Contractor must furnish a security guard or fire watch acceptable to the Owner to maintain security of the facility outside of normal working hours and will be held responsible for any losses from the facility.
2. The Contractor must maintain, at all times, dust control measures to the satisfaction of the Owner.

END OF SECTION 00750

SECTION 00800 SUPPLEMENTARY CONDITIONS

1. The following conditions must supplement the general conditions:

- a. The Contractor must provide invoices of material and equipment provided as part of the Project if requested by the Owner for use for utility energy incentive rebate programs. This information must be provided if requested before the final payment will be made.
- b. **All generator and switchboard work requiring shutdowns need to be completed on non-drill weekends. During shutdowns contractor must supply standby generators to keep medical refrigerators circuits energized.**

END OF SECTION 00800

SECTION 00850 FEDERALLY FUNDED PROJECT PREVAILING WAGE REQUIREMENTS/SCHEDULE

If a project is funded in whole or in part by federal dollars, the Contractor and all Subcontractors must comply with all Laws pertaining to occupational classifications and to the following requirements:

1. If applicable, the Contractor (and its Subcontractors) for prime construction contracts in excess of \$2,000 must comply with the Davis-Bacon Act ([40 USC 3141-3148](#)) as supplemented by Department of Labor regulations ([29 CFR Part 5](#), "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction").
2. The Contractor (and its Subcontractors) shall pay all mechanics and laborers employed directly on the site of the work, unconditionally and at least once a week, and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the advertised specifications, regardless of any contractual relationship which may be alleged to exist between the Contractor or subcontractor and the laborers and mechanics;
3. The Contractor will post the scale of wages to be paid in a prominent and easily accessible place at the site of the work;
4. There may be withheld from the Contractor so much of accrued payments as the contracting officer considers necessary to pay to laborers and mechanics employed by the Contractor or any Subcontractor on the work the difference between the rates of wages required by the Contract to be paid laborers and mechanics on the work and the rates of wages received by the laborers and mechanics and not refunded to the Contractor or Subcontractors or their agents.

END OF SECTION 00850

SECTION 00900 ADDENDA

1. Each Bid submittal must include acknowledgement of receipt and review of all Addenda issued during the Bidding period.

END OF SECTION 00900

DIVISION 01

GENERAL REQUIREMENTS

SECTION 01010 SUMMARY OF WORK

1. General

1.1 General information covering the "Scope of Work" is specified on the Invitation to Bid. Additional information is as follows:

(a). None.

1.2 The Agency will provide the following Work:

(a) State Salvage: The State reserves the right to salvage certain items and equipment and those salvaged items will be identified to the Bidder at the time of their inspection of the proposed Work. The State will remove salvaged items before commencement of the Work.

(b) Moving Furnishings and Equipment: The Contractor must give timely notice to the State Agency representative identified in the pre-construction meeting of all furnishings, window covering and movable equipment that will interfere with the Work or which the Contractor cannot protect with coverings of paper, plastic, drop cloths or clean tarpaulin. The Contractor must furnish, install, maintain, and remove all coverings used to protect furnishings, window coverings and movable equipment.

END OF SECTION 01010

SECTION 01020 ALLOWANCES

1. Allowances

1.1 Cash Allowances:

(a) Bidders must include in their Base Proposal Sum an allowance of \$0. The base bid shall include bonds and insurance on the value of the allowance.

(b) Monies in the allowance will be used only if directed in writing by the Project Director and Professional.

(c) Payments under a Cash Allowance must be on actual cost and exclude cost for supervision, handling, unloading, storage, installation, testing, fee, premiums for bond and insurance, etc.

(c) Unused allowances will be deducted from the contract amount through contract change order.

1.2 Provisional/Contingency Allowances:

(a) Bidders must include in their Base Proposal Sum a contingency allowance of \$150,000. The base bid shall include bonds and insurance on the value of the allowance.

(b) Monies will be used in the contingency allowance only if directed in writing by the Project Director and Professional.

(c) Payments under a Provisionary Allowance will include not only the purchase/furnished cost of the materials and equipment involved, but also all related labor costs, subcontract costs, construction equipment costs, general conditions costs and Fee, provided they are calculated in accordance with the requirements of the contract documents.

(c) Unused allowances will be deducted from the contract amount through contract change order.

END OF SECTION 01020

SECTION 01025 MEASUREMENT AND PAYMENT

1. **Schedule of Values:** Unless noted otherwise, before mobilization and start of construction, the Contractor must submit a Schedule of Values to the Professional for review and approval, of the various tasks that must be performed to complete all the Work. The schedule must show each task and the corresponding value of the task, including separate monies allocated for General Condition items and Project close-out. The aggregate total value for all tasks must be equal to the total Contract sum.

END OF SECTION 01025

SECTION 01030 ALTERNATES

1. **Use of Alternates:** Determination of the lowest three Bidders shall be based on the sum of the Base Bid and any additive and deductive Alternates the Owner accepts, in the order in which they are listed only. The Owner will accept an Alternate only if all other previously listed Alternates are also accepted unless acceptance by the Owner of Alternates in a different order does not affect determination of the lowest three bidders in any way.

2. **Execution:** (a) Coordinate pertinent related Work and modify surrounding work as required to complete the Project for each alternate.

(b) Description of Alternates: N/A

END OF SECTION 01030**SECTION 01040 COORDINATION****1. Project Coordination:**

- (a) Before beginning Work the Contractor must coordinate with the State Agency representative to implement the schedule for the Project. Once the Project is started, it must be carried to completion without delay.
- (b) Any building utility service interruptions or outages including security required by the Contractor in performing the Work must be prearranged with the staff of the State Agency and must occur only during those scheduled times.
- (c) The Contractor is not responsible for removing room furnishings unless is required by the Contract Documents.

2. Cutting and Patching:

- (a) The Contractor must do all cutting, fitting, or patching of the Work that may be required to make its several parts fit together properly or make new Work join with the existing structure. The Contractor must take proper precautions so as not to endanger any existing Work. The Contractor must not cut or alter existing structural members or foundations unless specifically required by the Contract Documents.
- (b) Holes or openings cut in exterior walls and roofs for installation of materials or equipment must be waterproofed by appropriate, approved materials and methods.
- (c) All adjacent finished surfaces that are damaged by the new Work must be patched with materials matching existing surfaces. Joints between patched and existing material must be straight, smooth, and flush. Workers skilled in its installation must apply all patching material.

END OF SECTION 01040**SECTION 01050 FIELD ENGINEERING**

1. When applicable, the Contractor must employ a surveyor who must establish and maintain all lines and levels required for laying out and constructing the Work. The Contractor agrees to assume all responsibility due to inaccuracy of any Work of the surveyor, and including incorrect benchmarks, their loss or disturbance. Upon completion of the Project, the Contractor must submit two copies of site layout Drawings prepared for the Project and certified by the surveyor.

END OF SECTION 01050**SECTION 01060 REGULATORY REQUIREMENTS**

1. **Laws:** The Contractor and its Subcontractors/Suppliers must comply with all Federal, State, and local Laws applicable to the Work and site.
2. **Codes:** All Works must be provided in accordance with the State Construction Code Act, 1972 PA 230, as amended, MCL 125.1501 et seq., International Building and Residential Codes and all applicable Michigan construction codes and fire safety including but not limited to: Michigan Building Code, Michigan Residential Code, Michigan Uniform Energy Code, Michigan Electrical Code, Michigan Rehabilitation Code for Existing Buildings, Michigan Mechanical Code, Michigan Elevator Code and Michigan Plumbing Code. If the Contractor observes that any Contract Document conflicts with any Laws or the State Construction Code or any permits in any respect, the Contractor must promptly notify the Professional in writing. If the Contractor provides any Work knowing or having to reason to know of such conflict, the Contractor must be responsible for that performance.
3. **Permits:** All required construction permits must be secured and their fees including inspection costs must be paid by the Contractor. The time incurred by the Contractor in obtaining construction permits must constitute time required to complete the Work and does not justify any increases to the Contract Time or Price, except when revisions to the Drawings and/or Specifications required by the permitting authority cause the Delays. The Contractor must pay all charges of Public Utilities for connections to the Work, unless otherwise provided by Cash Allowances specific to those connections.
4. **Taxes:** The Contractor must pay all Michigan sales and use taxes and any other similar taxes covering the Work that are currently imposed by legislative enactment and as administered by the Michigan Department of Treasury, Revenue Division. If the Contractor is not required to pay or bear the burden or obtains a refund of any taxes deemed to have been included in the Bid and Contract Price, the Contract Price must be reduced by a like amount and that amount, whether as a refund or otherwise, must ensure solely to the benefit of the State of Michigan.
5. **Safety and Protection:** The Contractor and its Subcontractors/Suppliers must comply with all applicable Federal, State, and local Laws governing the safety and protection of persons or property, including, but not limited to the Michigan Occupational Safety and Health Act (MIOSHA), 1974 PA 154, as amended, MCL 408.1001 et seq., and all rules promulgated under the Act. The Contractor is responsible for all damages, injury or loss to the Work, materials, equipment, fines, penalties as a result of any violation of such Laws, except when it's due to the fault of the Drawings or Specifications or to the Act, error, or omission of the

Owner or Professional. The Contractor is solely responsible for initiating, maintaining, and supervising all safety precautions and programs and such responsibility must continue until such time as the Professional is satisfied that the Work, or Work inspected, is completed and ready for final payment. In doing the Work and/or in the event of using explosives, the Contractor must take all necessary precautions for the safety of, and must erect and maintain all necessary safeguards and provide the necessary protection to prevent damage, injury or loss to: (a) all employees on the Work and other persons who may be affected by the Work, (b) all the Work and materials and equipment to be incorporated into the Work, whether stored on or off the site, and (c) other property at or adjacent to the site, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Utilities not designated for removal, relocation or replacement. In the event of severe weather, the Contractor must inspect the Work and the site and take all reasonably necessary actions and precautions to protect the Work and ensure that public access and safety are maintained.

6. Fire Hazard Conditions:

- (a) The fire hazard classification of finish materials where used in the specification must be in accordance with the current Michigan Building Code.
- (b) Classification must be determined by tunnel test in accordance with National Fire Protection Association (NFPA-255), American Society for Testing Materials (ASTM E-84) or Underwriters' Laboratories, Inc. (UL-723).

7. Flame/Smoke Resistance Standards: The Contractor must provide carpeting complying with "Class B" requirements as set forth in Michigan Department of State Police State Fire Safety Board "Health Care Facilities Fire Safety Rules" R29.1243, Rule 243, when tested in accordance with the following procedures:

- (a) Tunnel Test: Test for surface burning characteristics, with ratings for flame spread, fuel contribution, and/or smoke density; ASTM E 84, UL 723, or NFPA No. 255.
- (b) Pill Test: Test for flammability; ASTM D 2859, or DOC FF-1-70.
- (c) Floor Radiant Panel Test: Test for burning under varying radiant energy levels; ASTM E 648, with minimum average radiant flux ratings not less than 0.45 watts/sq. cm.
- (d) Smoke Density Test: Test in radiant heat chamber, with and without flame, for density of smoke generated; ASTM E 662, or NFPA No. 258, also known as NBS Smoke Density Chamber Test.

8. Michigan Right-To-Know Law: The Contractor and its Subcontractors/Suppliers must comply with MIOSHA, Michigan Right-to-Know Law (Public Act 80 of 1986) and the rules promulgated under it. The Act places certain requirements on employers to develop a communication program designed to safeguard the handling of hazardous chemicals through labeling of chemical containers and development and availability of Safety Data Sheets (SDS), and to provide training for employees who work with these chemicals and develop a written hazard communications program. The Act also provides for specific employee rights, including the right to be notified of the location of SDS and to be notified at the site of new or revised SDS within five Business Days after receipt and to request SDS copies from their employers. The Contractor, employer or Subcontractor must post and update these notices at the site.

9. Environmental Requirements: The Contractor and its Subcontractors/Suppliers must comply with all applicable Federal, State and local environmental Laws, standards, orders or requirements including but not limited to the National Environmental Policy Act of 1969, as amended, Michigan Natural Resources and Environmental Protection Act, P.A. 451 of 1994, as amended, the Clean Air Act, as amended, the Clean Water Act, as amended, the Safe Drinking Water Act, as amended, Pollution Prevention Act, as amended, Resource Conservation and Recovery Act, as amended, National Historic Preservation Act, as amended and Energy Policy and Conservation Act and Energy Standards for Buildings Except Low-Rise Residential Buildings, ANSI/ASHRAE/IESNA Standard 90.1-1999.

10. Nondiscrimination: For all State Contracts for goods or services in amount of \$5,000 or more, or for Contracts entered into with parties employing three or more employees; in connection with the performance of Work under this Contract, the Contractor and its Subcontractors and Suppliers must comply with the following requirements:

- 10.1 Not to discriminate against any employee or applicant for employment because of race, color, religion, national origin, age, sex (as defined in *Executive Directive 2019-09*), height, weight or marital status and take affirmative action to ensure that applicants are employed, and the employees are not subject to such discrimination. Such action must include, but is not limited to, the following: employment, upgrading, demotion or transfer; recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training.
- 10.2 To state in all solicitations or advertisements for employees that all qualified applicants will receive consideration for employment without regard to race, color, religion, national origin, age, sex, height, weight, or marital status.
- 10.3 To send, or have its collective bargaining representative send, each labor union or representative of workers with which there is a collective bargaining agreement or other contract or understanding, a notice advising the labor unions or workers' representative of the commitments under this provision.
- 10.4 To comply with the Elliot-Larsen Civil Rights Act, 1976 PA 453, as amended, MCL 37.2201 et seq.; the Michigan Persons with Disability Civil Rights Act, 1976 PA 220, as amended, MCL 37.1101 et Seq.; *Executive Directive 2019-09*; and all published rules,

regulations, directives, and orders of the Michigan Civil Rights Commission (MCRC) which may be in effect on or before the date of Bid opening.

- 10.5 The Contractor must furnish and file compliance reports within the times, and using the forms prescribed by the MCRC. Compliance report forms may also elicit information as to the practices, policies, programs, and employment statistics of the Contractor and Subcontractors. The Contractor must permit access to Records by the MCRC and its agent for purposes of ascertaining compliance with the Contract and with rules, regulations, and orders of the MCRC.
- 10.6 If, after a hearing held under its rules, the MCRC finds that the Contractor has not complied with the Elliott-Larson requirements of the Contract Documents, MCRC may, as part of its order, certify its findings to the Administrative Board of the State of Michigan, which may order the cancellation of the Contract and/or declare the Contractor ineligible for future contracts with the State until the Contractor complies with the MCRC's order.
11. **Michigan Residency for Employees:** Fifty percent of the persons employed on the Work by the Contractor must have been residents of the State of Michigan for not less than one year before beginning employment on the Work. This residency requirement may be reduced or waived to the extent that Michigan residents are not available or to the extent necessary to comply with the federal funds used for the Project. This requirement does not apply to employers who are signatories to collective bargaining agreements that allow for the portability of employees on an interstate basis.

END OF SECTION 01060

SECTION 01090 REFERENCES

1. References will be made in an abbreviated alpha numeric form to specific standard specifications, reference publications and building codes of federal or state agencies, manufacturers, associations, or trade organizations. Such references will be identified by the alphabetic abbreviation which identifies the government agency, the association or organization followed by the rule, section or detail number that are to form a part of these specifications, the same as if fully set forth herein, and must be of latest issued date in effect three months before the Bid opening date shown on the Proposal and Contract. The abbreviations used are referred to as follows:

<u>Abbreviation</u>	<u>Agency, Association or Organization</u>
ACI	American Concrete Institute
AISC	American Institute of Steel Construction, Inc.
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BOCA	Building Officials and Code
CDA	Copper Development Assn., Inc.
CLFMI	Chain Link Fence Manufacturer's Institute
CISPI	Cast Iron Soil Pipe Institute
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
F/M	Factory Mutual Research Corporation
FS	Federal Specifications
HEW	United States Department of Health Education and Welfare
MDOT	Michigan Department of Transportation
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation Testing Laboratory, Inc
NSWMA	National Solid Waste Management Association
PCA	Portland Cement Association
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal & Air Conditioning Contractors
UL	Underwriters Laboratories, Inc.
USBM	United States Bureau of Mines
USDC	United States Department of Commerce

END OF SECTION 01090

SECTION 01100 PROJECT PROCEDURES

1. **Signage and Safety:** The Contractor must post appropriate construction signs to advise the occupants and visitors of occupied facilities of the limits of construction work areas, hardhat areas, excavations, construction parking and staging areas, etc. Advertising signage by contractors, subcontractors, or suppliers is not allowed. The Contractor must maintain safe and adequate pedestrian and vehicular access to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, hospitals, fire, and police stations and like establishments. The Contractor must obtain written approval from the Owner ten Calendar Days before connecting to existing facilities or interrupting the services on site.
2. **Barrier and Enclosures:**
 - (a) The Contractor must furnish, install, and maintain as long as necessary and remove when no longer required adequate barriers, warning signs or lights at all dangerous points throughout the Work for protection of property, workers, and the public. The Contractor must hold the State of Michigan harmless from damage or claims arising out of any injury or damage that may be sustained by any person or persons as a result of the Work under the Contract.
 - (b) **Temporary Fence:** The Contractor must entirely enclose the Contract area by means of woven wire or snow fence having minimum height of four feet. Gates must be provided at all points of access. Gates must be closed and secured in place at all times when Work under the Contract is not in progress. The fence must be removed, and grounds restored to original condition upon completion of the Work.
 - (c) **Street Barricades:** The Contractor must erect and maintain all street barricades, signal lights and lane change markers during the periods that a traffic lane is closed for their operations. There must be full compliance with rules and ordinances respecting such street barricading and devices must be removed when hazard is no longer present.
3. **Construction Aids:**
 - (a) The Contractor must furnish, install, and maintain as long as necessary and remove when no longer required, safe and adequate scaffolding, ladders, staging, platforms, chutes, railings, hoisting equipment, etc., as required for proper execution of the Work. All construction aids must conform to Federal, State, and local codes or Laws for protection of workers and the public.
 - (b) **Debris Chute:** The Contractor must use a chute to lower debris resulting from their Work. The chute must be the enclosed type with its discharge directly into the truck or approved container.
 - (c) **Pumping and Drainage:** The Contractor must provide all pumping necessary to keep excavations and trenches free from water the entire period of Work on the Contract. The Contractor must construct and maintain any necessary surface drainage systems on the Work site so as to prevent water entering existing structures or to flow onto public or private property adjacent to the Agency's land, except for existing drainage courses or into existing drainage systems. The Contractor must prevent erosion of soils and blockage of any existing drainage system.

END OF SECTION 01100

SECTION 01200 PROJECT MEETINGS

1. **Pre-Construction Conferences:** The Project Director will schedule a pre-construction conference to be attended by the Professional, State Agency staff, and the Contractors. A project procedure as outlined in Form DTMB-0460, will be established for the Work during the pre-construction meeting. When no organizational meeting is called, the Contractor, before beginning any Work, must meet with the staff of the Agency and arrange a Work schedule for the Project. Once the Project has been started, the Contractor must carry it to completion without delay.
2. **Progress Meetings:** The Professional will schedule progress meetings to be held on the job site whenever needed to supply information necessary to prevent job interruptions, to observe the Work or to inspect completed Work. The Contractor must be represented at each progress meeting by persons with full authority to act for the Contractor in regard to all portions of the Work.

END OF SECTION 01200

SECTION 01300 SUBMITTALS

1. **Shop Drawings, Samples and Technical Submittals:**
 - 1.1 **Contractor's Review:** Before each submission, the Contractor must:
 - (a) determine and verify all field measurements, quantities, dimensions, instructions for installation and handling of equipment and systems, installation requirements (including location, dimensions, access, fit, completeness, etc.), materials, color, catalog numbers and other similar data as to correctness and completeness, and
 - (b) have reviewed and coordinated that technical Submittal with other technical submittals and the requirements of the Contract Documents.
 - 1.2 **Notice of Variation:** The Contractor must give the Professional specific written notice of any variation from the requirements of the Contract Documents.

- 1.3 Contractor's Approval:** The Contractor shall not submit unapproved submittals. Each submittal shall be stamped/certified to indicate that the submittal satisfies the requirements of the Contract Documents before submission to the Professional.
- 1.4 Responsibility and Authority:** Neither the Owner's authority to review any of the Submittals by the Contractor, nor the Owner's decision to raise or not to raise any objections about the Submittals, creates or imposes any duty or responsibility on the Owner to exercise any such authority or decision for the benefit of the Contractor/Subcontractor/Supplier, any surety to any of them or any other third party. The Contractor is not relieved of responsibility for errors or omissions in shop drawings, product data, samples, or similar submittals just because the Professional approved them for general design intent.
- 1.5 Final As-Built/Record Documents and Submittals:** The approved Submittals are a part of the final As-Built/Record Documents required for processing final payment to the Contractor.
- 1.6 Submissions:** Contractor must submit to the Professional:
- Contractor to submit shop drawings to the Department of Military Affairs. Submit electronic versions of the submittals, upon approval contractor to submit two hard copies of each to DMVA; and
 - all required samples; and
 - all other technical submittals (test, results, test and safety procedures, O&M manuals, etc.) that are required by the Contract Documents.
- 1.7 Professional's Review and Return:** Professional's Review and Return: Submittals will be returned to the Contractor within fifteen Calendar Days. The Contractor is responsible for any time Delay and any cost incurred by the Professional, Contractor or Subcontractors/Suppliers as a result of resubmissions and re-reviews of a particular Submittal. The Contractor shall revise, and correct submittals returned for revision and resubmittal until approval by the Professional is achieved. All time consumed by the resubmissions and rereviews of a particular Submittal shall constitute time required to furnish that Submittal or shall represent Delays not justifying any increase in Contract Time or Contract Price, or both.
- 2. Progress Schedule:**
- 2.1 SUMMARY**
- The **Contractor** will submit CPM Progress Schedules to the **Owner** depicting its approach to prosecution of the Work. This includes but is not limited to the **Contractor's** approach to recovering schedule and managing the effect of changes, substitutions, and Delays on Work sequencing.
 - The Progress Schedule will include the Rev. 0 Submittal (par. 2.14), Update Submittals (par. 2.15) and Revision Submittals (par. 2.16). Each Submittal will be assigned a unique number. For a resubmission, the initial number will be modified by the letter A, B, C, etc., as appropriate.
 - Through the Progress Schedule, the **Owner** will seek to stay current on progress, updated Activity and Milestone Dates, and the **Contractor's** approach to Work remaining.
 - References to the Critical Path Method (CPM) are to CPM construction industry standards that are consistent with the requirements of this Section.
- 2.2 RELATED SECTIONS**
- Section 00700 General Conditions; and Section 00800 Supplementary Conditions.
- 2.3 GLOSSARY OF TERMS**
- Capitalized terms not already defined in any Division 0 Specification have the following intent and meanings:
 - Milestone—A key point of progress, designating interim targets toward the Contract Times. They may pinpoint critical path foundations, key deliveries, building framing, start of MEP rough-in, building enclosure, partitions, interior finishes, conditioned space, commissioning stages, Substantial Completion, and other events of like import.
 - Official Schedule—The most recent Revision Submittal returned to the **Contractor** as Resubmittal Not Required. The Rev. 0 Official Schedule is the *As-Planned* Schedule.
 - Revision 0 Submittal—Progress Schedule submitted by the **Contractor** depicting the entire Work as awarded.
 - Update Submittal—A monthly Progress Schedule update reflecting progress and minor adjustments on the Activities, sequencing and restraints for Work remaining.
- 2.4 QUALITY ASSURANCE**
- The **Contractor** will obtain a written interpretation from the **Professional**, if the **Contractor** believes the selection of Activities, logic ties or restraints requires an interpretation of the Contract Documents. With each submission, the **Contractor** will point out by specific, written notation, any Progress Schedule feature that may reflect variations from any requirements of the Contract Documents.
 - The **Contractor** is responsible to obtain information from each Subcontractor and Supplier when scoping their respective Activities, Values, logic ties and restraints
 - No review of any Progress Schedule by or on behalf of the **Owner** will relieve the **Contractor** from complying with the Contract Times and any required sequence of Work or from completing Work omitted from the Progress Schedule. No review will imply approval of any variation from or interpretation of the Contract Documents, unless approved by the **Professional** through a written interpretation or by means of a separate, written notation.
- 2.5 ALLOWANCES**
- Work covered by Cash Allowances will be completed within the Contract Times. To the extent reasonable and consistent with the **Contractor's** plan, Work authorized by provisional contingency allowances will be completed within the Contract Times. The Progress Schedule will incorporate the **Contractor's** best estimate of the Activities, logic and restraints required, using the information in the Contract Documents, or as indicated by the **Professional** in writing.

2.6 "OR EQUALS" AND SUBSTITUTIONS

A. Activities in the Rev. 0 Progress Schedule will be based on materials and equipment required by the Contract Documents and will not reflect any "or equal" or substitute materials or equipment, even if the **Contractor** intends to pursue "or equal" and substitution proposals. This limitation also applies to any Means and Methods indicated in or required by the Contract Documents.

2.7 MEASUREMENT AND PAYMENT

A. The Schedule of Values will include a Progress Schedule *pay item*. Fifteen percent (15%) of this *pay item* will be eligible for payment upon delivery of the *complete* Rev. 0 Submittal. The balance of this *pay item* will be eligible for payment, on a prorated basis, with each Request for Payment attaching an Update Submittal.

2.8 PROGRESS SCHEDULE SUBMITTALS

A. Each Progress Schedule Submittal will consist of an electronic copy the **Contractor's file**, a narrative and a PDF file of the project schedule report and plots, each file appropriately titled for the schedule version and date of publishing.

B. The CPM scheduling software will be Primavera Project Planner®, SureTrak® or Microsoft Project®.

C. In addition to the monthly update schedule submittal, **Contractor** shall provide prior to each Progress Meeting, a 2-week look ahead schedule extracted from the current overall schedule and providing sufficient additional activity detail to appropriately define the expected activity during the upcoming 2-week period.

2.9 PRINTOUTS

A. Schedule Reports will include Activity (ID) code and description, duration, calendar, Early Dates, Late Dates and Total Float, all of which will comport with the requirements of paragraph 8.3.4 of Section 00700 General Conditions.

1. Late Finish Date for an Activity pinpointing a Contract Time will equal that Contract Time. Early Start Date for an Activity designating a Contract restraint will equal the proper Notice to Proceed date. Schedule Reports may or may not append CPM Plots (time-scaled Activity/logic).

2. For Precedence Diagram Method, separate Schedule Reports will tabulate, for each Activity, all preceding and succeeding logic types and lead times, whether CPM Plots displaying vertical logic ties are appended or not.

B. CPM Schedule Plots will be plotted on a suitable time scale and identify the Contract Times, Critical Paths, and sub-Critical Paths. Activities will be shown on the Early Dates with Total Floats noted by Late Date flags.

c. Line of Balance Plots will reflect industry practice for repetitive construction and will segregate the production lines for all trades within the hammock Activities.

2.10 NARRATIVE REQUIREMENTS

A. In general, a narrative will describe the **Contractor's** approach to prosecution of the Work, subject to the requirements of the Contract Documents. Further, each narrative will list the Critical Path Activities and compare Early and Late Dates with Contract Times and Milestone Dates. The basis for restraint dates will be explained.

B. For each Update Submittal, the narrative will compare current Dates to the respective Milestone Dates, describe changes in crewing and construction equipment and identify new Delays. For each Revision Submittal, the narrative also will itemize changes in Activities, logic ties and restraint dates made necessary by each change, Delay, schedule recovery, substitution and **Contractor**-initiated revision occurring since the previous Submittal.

2.12 ACTIVITY REQUIREMENTS

A. The Progress Schedule will detail Work sequencing only to the extent necessary to allow the **Owner** to correlate percent complete, compare actual dates with Milestones and Contract Times and the data in Requests for Payment.

B. Separate Activities will designate permits, construction, Submittal preparation/review (and resubmission and re-review, for same); MEP coordination drawings; deliveries; commissioning; and Punch List. Separate Activities will designate **Owner**-furnished items, interface with other work and the **Owner** and **Professional's** responsibilities.

C. Activities will be detailed only to the extent required to show the transition of trade Work. Activities will detail the progression through site/excavation, foundations, building framing, start/completion of interior partitions, MEP rough-in, building enclosure, interior finishes, conditioned space, and commissioning.

1. Submittal Activities will segregate long-lead items, any item requiring structural access and other procurements that, in the **Contractor's** judgment, may bear on the rate of progress. Separate MEP coordination drawing Activities will be used for each floor. Beyond these requirements, it is not necessary to burden the Progress Schedule with Activities for less significant Submittals and deliveries.

2. For multiunit Work (e.g., rough-in overhead MEP for each floor, etc.), detailed Activities will be shown for a typical (often, the first) unit). Other or follow-on units may be replicated, as appropriate, or modeled with a hammock Activity combining the sum total of the typical detailed Activities. Separate Activities, as may be suitable to the Divisions of Work involved, will be identified for single-unit Work. This requirement applies to such scope as Work in mechanical rooms, building framing, commissioning, etc.

3. Activities will not combine separate or non-concurrent items of Unit Price or lump sum Work, Work in separate structures and Work in distinct areas, locations or floors within an area or structure; or rough-in and finish Work.

D. Activity durations will equal the Business Days required to sufficiently complete the Work designated by the Activity (i.e., when finish-to-start successors may start, even if the Activity is not quite 100% complete). Installation Activities will last from twenty (20) to forty (40) Days.

E. Activities will be assigned consistent descriptions and identification codes. Sort codes will group Activities by building or structure, floor or area, Change Order and Change Authorization and other meaningful schemes.

2.13 FLOAT TOLERANCES

A. Any Progress Schedule with Early Dates after a Contract Time will yield negative Total and Contract Floats, whether shown/calculated or not. Any Revision Submittal with less than negative twenty (20) Days of Float will be returned as "Revise and Resubmit," unless a time extension is requested, or the **Owner** withholds liquidated damages or asserts intent to do so in the event schedule is not recovered.

B. Floats calculated from the definitions given in Section 00020 Glossary supersede any conflicting Float values calculated within any early completion Progress Schedule.

2.14 REVISION 0 (Rev. 0) SUBMITTAL

A. The complete Revision 0 Submittal will be due with the first Request for Payment. The Rev. 0 Submittal will show the Work as awarded, without Delays, "or equal" or substitutions, Change Orders or Change Authorizations.

1. The Rev. 0 narrative will detail the **Contractor's** management of the site (lay down, parking, etc.). Further, the Rev. 0 narrative will identify shifts, weekend Work, Activity calendars, Delays since award and all pending and anticipated "or equal" and substitution proposals.

B. Once endorsed by the **Owner** and returned as "Resubmittal Not Required," the Rev. 0 Progress Schedule (or Rev. 0A, etc.) will be the As-Planned Schedule and the basis for Update Submittals until the Rev. 1 Official Schedule is established. Once the As-Planned Schedule is established, the **Owner** will select Milestones and note Milestone Early and Late Dates. As the Official Schedule evolves, Milestone Dates will be revised accordingly.

D. If the **Owner** refuses to endorse the Rev. 0 Submittal (or Rev. 0A, for a resubmission) as "Resubmittal Not Required," the As-Planned Schedule will not be established. In that event, the **Contractor** will continue to submit Update and Revision Submittals reflecting progress and the **Contractor's** approach to remaining Work. The **Owner** will rely on the available Update and Revision Submittals, subject to whatever adjustments it determines appropriate.

2.15 UPDATE SUBMITTALS

A. Update Submittals with progress up to the closing date and updated Early and Late Dates for progress and remaining Activities will be due with each Request for Payment. As-built data will consist of actual start dates, percent complete, actual finish dates, changes, Delays, and other significant events occurring before the closing date.

2.16 REVISION SUBMITTALS

A. Progress Schedule Revisions will be submitted with the third Request for Payment and every two (2) months after that, or more often, if necessary due to schedule recovery or other Progress Schedule revisions. Revisions will revise the Update Submittal attached to the prior Request for Payment.

B. Progress Schedule revisions will detail all impacts on pre-existing Activity scope, logic ties and restraint dates and reflect the Contractor's current approach to Work remaining. Revisions may be required because of changes in the Work, substitutions, schedule recovery and Delays.

C. Once endorsed by the **Owner** and returned as "Resubmittal Not Required," a Revision Submittal becomes the Rev. 1, Rev. 2, etc. Official Schedule and the basis for subsequent Update Submittals until a more current Official Schedule is established. If the **Owner** refuses to endorse a Revision Submittal as "Resubmittal Not Required," the **Contractor** will continue to submit Update and Revision Submittals when and as required in this Section.

2.17 RETROSPECTIVE DELAY ANALYSIS

A. If the **Owner** refuses to endorse any Revision Submittal as "Resubmittal Not Required," the **Contractor** and **Owner** will use the latest Official Schedule when evaluating the effect of Delays on Contract Time and/or Contract Price. The procedure will consist of progressively revising the latest Official Schedule at key Revision Submittal closing dates. For each Progress Schedule iteration, slippage between actual Milestone Dates and Rev. 0 Milestone Dates will be correlated to Delays occurring solely in that iteration. Revisions affecting Work after any iteration will be included only to the extent consented by the **Owner** at that time and/or if confirmed by as-built progress.

3. **Shop Drawings:** The Contractor shall deliver shop drawings of products, materials, assemblies, or equipment to the Professional.

Karrie Baker
DMVA-CFMO
Design Services Section
3423 N. Martin Luther King Blvd.
Lansing, MI 48906

4. **Samples:** The Contractor must deliver all samples of material or equipment to the job site for examination by the State Agency and the Professional. Samples will be examined by the Professional for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents. The Contractor must furnish all Work in accordance with approved samples. The following general classifications of material and equipment require submission of samples. Samples of other items may be requested by the Professional at any time.

<u>Item of Work</u>	<u>Type of Sample</u>	<u>Section Number</u>
Unit Masonry	Sample Units	042000
Interior Finish Carpentry	Sample Units	062023
Joint Sealants	Color Samples	079200
Decorative Films	Sample Units	088733
Ceramic Tiling	Sample Units	093013
Acoustical Panel Ceilings	Sample Units	095113
Resilient Base	Sample Units	096513
Resilient Tile Flooring	Sample Units	096519
Painting	Color Samples	099100
Panel Signage	Sample Units	101423
Plastic Toilet Compartments	Sample Units	102113
Shower and Dressing Compar.	Sample Units	102116
Accordion Folding Partitions	Sample Units	102233
Vertical Louver Blinds	Sample Units	122116

Roller Shades
Residential Casework

Sample Units
Sample Units

122413
123530

END OF SECTION 01300

SECTION 01400 QUALITY CONTROL

1. **Testing Laboratory Services:** All tests required by the Owner must fulfill ASTM, ANSI, Commercial and other Standards for testing. The Contractor must submit a minimum of three copies of each test report to the Professional for evaluation and subsequent distribution. The following general classifications of Work require submission of test reports and/or certificates of inspection. Additional submissions may be requested by the Professional at any time.

<u>Item of Work</u>	<u>Test Type</u>	<u>Section Number</u>
Cast in place Concrete	Compression Tests	033000
Earth Moving	Compaction	312000

2. **Tests:**

- (a) Paid by Contractor:

3. **Concrete/Asphalt Materials:** Before placement of any concrete, the Contractor must submit for the Professional's approval complete data on the trial concrete mix formulation and a testing laboratory report for ASTM C94, twenty-eight-day standard cylinder test for compressive strength of a sample of the concrete mix. For asphalt paving, the Contractor must submit the data and testing reports for ASTM D946, AC-5. The mix must have 4.5 to 6 percent of asphalt cement by weight for binder course and 5 to 7 percent of asphalt cement by weight for surface course in accordance with Asphalt Institute Manual MS-4, MS-13, and the current Michigan Department of Transportation (MDOT) Standard Specifications for Construction.

- (a) The Contractor must furnish to the Professional tickets showing mix formulation, Contractor's name, Project name, mix identification for each load of concrete/asphalt delivered and installed. If the technical specifications allow added water to the concrete mix after leaving the batch plant, the delivery ticket must reflect the added water. The Owner Field Representative must receive a copy of each delivery ticket for transmittal to the Professional for evaluation.
- (b) The Professional may require the Contractor to core drill questionable cast-in-place concrete/asphalt for laboratory testing. Should the laboratory analysis indicate the concrete/asphalt fails to meet specification requirements, the Contractor must pay all costs for core drilling and testing in the laboratory and replace the concrete/asphalt found to fail meeting the specification requirements. Should the laboratory analysis confirm that the concrete/asphalt meets specification requirements, the Owner will pay the Contractor for their costs for core drilling, concrete/asphalt patching and the laboratory fee for testing of the concrete/asphalt core samples.

END OF SECTION 01400

SECTION 01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1. The Contractor must furnish and install all temporary facilities and controls required by the Work, must remove them from State property upon completion of the Work, and the grounds and existing facilities must be restored to their original condition.
2. If water or electricity is available in the area where Work will be performed, the Contractor will not be charged for reasonable use of these services for construction operation. The Contractor must pay costs for installation and removal of any temporary connections including necessary safety devices and controls. Use of services must not disrupt or interfere with operations of the State Agency.
3. **Temporary Sanitary Facilities:**
 - (a) **Portable Toilets:** The Contractor must provide and maintain a sufficient number of portable temporary toilets in locations approved by the State Agency. They must comply with all Federal, State, and local code requirements. The Contractor must maintain the temporary toilets in a sanitary condition at all times and must remove them when the Work under this Contract is complete. The Contractor's employees are not allowed to use any existing State toilet facility.
4. **Field Office:**
 - (a) **On Site Trailer:** At the beginning of the Work, the Contractor may provide a field office and storage building at the site in a location acceptable to the Owner. The building may be a trailer. The Contractor may provide such other temporary buildings as he may require for the use of workers and safe storage for tools and materials. Job signs with the Contractor's name, logos, specialty, ... etc., are not allowed.

- (b) At no time will the contractor be allowed to store materials in any buildings on Grayling Army Airfield. The buildings under this contract will remain locked. If contractor requires access to the building, a request must be submitted to the on-site field inspector, and they will unlock the building.
5. **Temporary Heating:** Until the new heating system is ready to provide heat, the Contractor must provide adequate temporary heaters to maintain the temperature in those areas of the building where Work is being conducted between 55 degrees F. and 70 degrees F. during working hours.

END OF SECTION 01500

SECTION 01600 MATERIAL AND EQUIPMENT

1. The Contractor must furnish and be responsible for all materials, equipment, facilities, tools, supplies and utilities necessary for completing the Work. All materials and equipment must be provided as described in the Contract Documents and of good quality, free of defect and new and must be applied, installed, connected, erected, used, cleaned and conditioned following the manufacturer's and Suppliers' instructions.
2. **Delivery, Storage, and Handling:** All materials and equipment delivered to and used in the Work must be suitably stored and protected from the elements. The areas used for storage must only be those approved by the State Agency. The Owner assumes no responsibility for stored material. The ownership and title to materials will not be vested in the Owner before materials are incorporated in the Work unless payment is made by the Owner for stored materials and equipment. After delivery, before and after installation, the Contractor must protect materials and equipment against theft, injury, or damage from all causes. For all materials and equipment, the Contractor must provide complete information on installation, operation, and preventive maintenance.
- (a) The Contractor must cover and protect bulk materials while in storage which are subject to deterioration because of dampness, the weather or contamination. The Contractor must keep materials in their original sealed containers, unopened, with labels plainly indicating manufacturer's name, brand, type, and grade of material and must immediately remove from the Work site containers which are broken, opened, watermarked and/or contain caked, lumpy, or otherwise damaged materials.
- (b) The Contractor must keep equipment stored outdoors from contact with the ground, away from areas subject to flooding and covered with weatherproof plastic sheeting or tarpaulins.
- (c) The Contractor must certify that any materials stored off-site are:
- Stored on property owned or leased by the Contractor or owned by the agency.
 - Insured against loss by fire, theft, flood, or other hazards.
 - Properly stored and protected against loss or damage.
 - In compliance with the plans and specifications.
 - Specifically allotted, identified, and reserved for the project.
 - Itemized for tracking and payment.
 - Subject to these conditions until the items are delivered to the project site.

END OF SECTION 01600

SECTION 01650 FACILITY START-UP

1. **Tests:** The complete installation consisting of the several parts of equipment and systems installed according to the requirements of the Contract Documents must be ready in all respects for use by the State Agency and must be subjected to a test at full operating conditions and pressures for normal conditions of use.
2. **Adjustments:** Contractor must adjust and replace the Work which is necessary to fulfill the requirements of the Contract Documents and to comply with the directions and recommendations of the manufacturer of the several parts of equipment, and to comply with all provisions of architectural and/or engineering drawings/specifications and all codes and regulations which may apply to the entire installation.
3. **Demonstration:** Contractor must provide an on-site demonstration and training of all systems operations to the Owner when it is substantially completed.

END OF SECTION 01650

SECTION 01700 CONTRACT CLOSE-OUT

1. **Substantial Completion:** The Contractor must notify the Professional, the Project Director and the Agency when the Work will be substantially complete. If the Professional, Owner, and Agency agree that the project is Substantially Complete, the

Professional and Project Director will inspect the Work. The Professional, upon determining that the Work, or a portion of the Work inspected, is substantially complete, will prepare a Punch List and will attach it to the respective Certificate of Substantial Completion. The Contractor must be represented on the job site at the time this inspection is made and thereafter must complete all Work by the date set for final acceptance by the Owner.

2. **Cleaning:**

- (a) **Regular Cleaning:** The Contractor must remove all scrap or removed material, debris, or rubbish from the Project work site at the end of each working day and more frequently whenever the Owner Field Representative deems such material to be a hazard. The Contractor cannot discard materials on the grounds of the State Agency without the express permission of the Project Director. No salvage or surplus material may be sold on the premises of the State Agency. No burning of debris or rubbish is allowed. Any recyclable materials must be recycled, and the Contractor will be required to provide recycling plan.
- (b) **Final Cleaning:** Before final acceptance by the State, the Contractor must clean all Work and existing surfaces, building elements and contents that were soiled by their operations and make repairs for any damage or blemish that was caused by the Work.

END OF SECTION 01700

SECTION 01800 MAINTENANCE

- 1. The Contractor is responsible for maintaining the following parts of Work in good order and proper working conditions and must take all necessary actions for their protection until they are placed for use by the Owner:

END OF SECTION 01800

SECTION 01900 – EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Installation of the Work.
 - 2. Dust control.
 - 3. Cutting and patching.
 - 4. Progress cleaning.
 - 5. Protection of installed construction.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

- A. Dust Control Plan – Plan shall show how dust will be contained and removed during drilling, coring and cutting operations.
 - 1. Plan contents.
 - a. Coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate.
 - 2. Do not start work without approved dust control plan. If work is done under this contract begins prior to approved plan contractor shall take full responsibility for cleaning or replacing any and all computer and communications equipment that is contaminated with dust.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
 3. Before digging Call the MISS DIG system. 811 or 800-482-7171.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 4. If any conditions are found to be detrimental to the performance of the Work as required provide a written statement to the Design Professional with the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 00700 "GENERAL CONDITIONS."
- E. Surface and Substrate Preparation: Comply with manufacturer's written recommendations for preparation of substrates to receive subsequent work.

3.3 DUST CONTROL

- A. Contractor shall provide dust control in accordance with approved dust control plan. All concrete dust shall be contained and disposed of during drilling, coring and cutting operations. Room has sensitive equipment that must be protected from dust.
 1. Do not start work without approved dust control plan. If work is done under this contract begins prior to approved plan contractor shall take full responsibility for cleaning or replacing any and all computer and communications equipment that is contaminated with dust.
- B. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.

2. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
3. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
4. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
5. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

- A. Also see Section 01040 COORDINATION for additional Cutting and Patching Requirements.
- B. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- C. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- D. Temporary Support: Provide temporary support of work to be cut.
- E. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- F. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Pavement: Cut using a cutting machine, such as an abrasive saw to provide smooth straight cut for clean butt joint with new work.
 - 5. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 6. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 7. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 2. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 3. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

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

END OF SECTION 01900

SECTION 01920 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Design Professional.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.
- C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Design Professional will return copy with comments.
 - 1. Correct or revise each manual to comply with Design Professional's comments. Submit copies of each corrected manual within 15 days of receipt of Design Professional's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.
- B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.

2. Table of contents.
 3. Manual contents.
- C. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

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

2.3 OPERATION MANUALS

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

8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
- 2.4 PRODUCT MAINTENANCE MANUALS
- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.

- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.

END OF SECTION 01920

SECTION 01930 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Product Data.
- B. Related Requirements:
 - 1. Section 01300 "SUBMITTALS".

1.2 SUBMITTALS

- A. Record Drawings: Submit PDF electronic files of scanned record prints and **three** paper copy sets of prints.
- B. Record Product Data: Submit PDF electronic files and three paper copies of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it.
 - c. Record and check the markup before enclosing concealed installations.
 - 2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 - 5. Prior to submittal Contractors authorized Representative shall review and mark each record drawing sheet with red ink as follows:
 - a. Print or stamp "PROJECT RECORD DRAWING" in a prominent location.
 - b. Date of review.
 - c. Contractors Authorized Signature.
- B. Format: Submit three bound paper set of record prints and one annotated PDF electronic file.

2.2 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
 - 4. Prior to submittal Contractors authorized Representative shall review updated product data, then prepare a cover sheet with an index of updated product data and mark cover sheet with red ink as follows:
 - a. Print or stamp "PROJECT RECORD SPECIFICATION in a prominent location.
 - b. Date of review.
 - c. Contractors Authorized Signature.
- B. Format: Submit three bound paper set of record Product Data with cover sheet and one PDF electronic file.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

END OF SECTION 01930

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
 - 2. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 60 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.4 SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste in tons.
 4. Quantity of waste salvaged, both estimated and actual in tons.
 5. Quantity of waste recycled, both estimated and actual in tons.
 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- 1.5 QUALITY ASSURANCE
- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- 1.6 WASTE MANAGEMENT PLAN
- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.

5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- 3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL
- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.
 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.
- 3.4 DISPOSAL OF WASTE
- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

3.5 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.
- F. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.
- G. Form CWM-7 for construction waste
- H. Form CWM-8 for demolition waste.

END OF SECTION 017419

DMVA CFMO

PROJECT NAME

RENOVATE ARMORY

LOCATION

DETROIT LIGHT GUARD ARMORY

FILE NUMBER

511/23337.AGY

FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION

MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED* (A)	EST. WASTE - % (B)	TOTAL EST. QUANTITY OF WASTE* (C = A x B)	EST. VOLUME CY (CM)	EST. WEIGHT TONS	REMARKS AND ASSUMPTIONS
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

* Insert units of measure.

DMVA CFMO

PROJECT NAME RENOVATE ARMORY
 LOCATION DETROIT LIGHT GUARD ARMORY
 FILE NUMBER 511/23337.AGY

FORM CWM-2: DEMOLITION WASTE IDENTIFICATION

MATERIAL DESCRIPTION	EST. QUANTITY	EST. VOLUME CY	EST. WEIGHT TONS	REMARKS AND ASSUMPTIONS
Asphaltic Concrete Paving				
Concrete				
Brick				
CMU				
Lumber				
Plywood and OSB				
Wood Paneling				
Wood Trim				
Miscellaneous Metals				
Structural Steel				
Rough Hardware				
Insulation				
Roofing				
Doors and Frames				
Door Hardware				
Windows				
Glazing				
Acoustical Tile				
Carpet				
Carpet Pad				
Demountable Partitions				
Equipment				
Cabinets				
Plumbing Fixtures				
Piping				
Piping Supports and Hangers				
Valves				
Sprinklers				
Mechanical Equipment				
Electrical Conduit				
Copper Wiring				
Light Fixtures				
Lamps				
Lighting Ballasts				
Electrical Devices				
Switchgear and Panelboards				
Transformers				
Other:				

DMVA CFMO

PROJECT NAME
LOCATION
FILE NUMBER

RENOVATE ARMORY
DETROIT LIGHT GUARD ARMORY
511/23337.AGY

FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS	EST. AMOUNT RECYCLED TONS	EST. AMOUNT DISPOSED TO LANDFILL TONS	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

DMVA CFMO

PROJECT NAME RENOVATE ARMORY
 LOCATION DETROIT LIGHT GUARD ARMORY
 FILE NUMBER 511/23337.AGY

FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS	EST. AMOUNT RECYCLED TONS	EST. AMOUNT DISPOSED TO LANDFILL TONS	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. APPENDIX III Special Project Procedures
 - a. Demolition and Remodeling Procedures.
 - b. Hazardous Material Project Procedures.
 - c. Asbestos Abatement Project Procedures.
2. Section 01010 Summary of Work.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 MATERIALS OWNERSHIP

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

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.4 SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.**

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

- C. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.5 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Notify DMVA of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Survey of Existing Conditions: Record existing conditions by use of measured drawings.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, electrical, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements specified in Section 01100 "Special Project Procedures".
 - 6. Comply with Dust Control Requirements in Section 01900 "Execution Requirements".
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

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

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.
- D. Material certificates.
- E. Material test reports.
- F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1.4 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1.
 - 1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301.

2. ACI 117.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064, flat sheet.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.4 CONCRETE MATERIALS

- A. Cementitious Materials:
 1. Portland Cement: ASTM C 150, Type I/II.
 2. Fly Ash: ASTM C 618, Class F or C.
 3. Slag Cement: ASTM C 989, Grade 100 or 120.
 4. Blended Hydraulic Cement: ASTM C 595, cement.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
 1. Maximum Coarse-Aggregate Size:
 - a. 3/4 inch nominal for interior slabs on grade.
 - b. 1 1/2 inches nominal for all other areas.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C 260.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494, Type A.
 2. Retarding Admixture: ASTM C 494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- E. Water: ASTM C 94 and potable.

2.5 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.6 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- B. Water: Potable.
- C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class A & B.
- D. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. 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 w/c ratio below 0.50.

2.9 CONCRETE MIXTURES

- A. Normal-Weight Concrete Exterior:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Minimum Cementitious Materials Content: 520 lb/cyd.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery.
- B. Normal-Weight Concrete Interior:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Minimum Cementitious Materials Content: 520 lb/cyd.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.10 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by DMVA Project Manager.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish.

- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighthen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces to all floor slabs not receiving ceramic or quarry tile.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with DMVA Project Manager before application.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by DMVA Project Manager. Remove and replace concrete that cannot be repaired and patched to Project Manager's approval.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to DMVA Project Manager, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by DMVA Project Manager. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by DMVA Project Manager.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 034001 - PRECAST CONCRETE RETAINING WALL SYSTEM**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete segmental retaining wall units.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.
- C. Shop Drawings:
 - 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1.4 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 REFERENCE STANDARDS

- A. ASTM C94 Ready-Mixed Concrete.
- B. ASTM C1372 Segmental Retaining Wall Units.

2.2 RETAINING WALL SYSTEM

- A. Wall Units: Machined formed, Portland cement concrete blocks.
 - 1. Type: **Versa-Lok Brute** retaining wall units.
- B. Color: Sandard.
- C. Wall Blocks: Cast to dimensions shown on Drawings.
 - 1. 28 Day Compressive Strength: 3,000 psi.

2.3 RETAINING WALL UNIT CONNECTION PINS

- A. Units shall be interlocked with Brute connection pins. The pins shall consist of glass-reinforced nylon made for the expressed use with the SRW units supplied.

2.4 GEOTEXTILE FABRIC SEPARATION LAYER

- A. As required by manufacturer.

2.5 ACCESSORIES

- A. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine subgrade and base for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.2 INSTALLATION

- A. Retaining wall system shall be constructed in accordance with manufacturer's installation instructions.
- B. Contractor shall excavate to the lines and grades shown on the Drawings.

- C. Erect precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.

3.3 REPAIRS

- A. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Remove and replace damaged precast concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.4 CLEANING

- A. Clean exposed surfaces of precast concrete units after erection and to remove markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034001

SECTION 042000 - UNIT MASONRY**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Brick.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
- C. Samples for Verification: For each type and color of exposed masonry unit and colored mortar.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1.3 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 CONCRETE LINTELS

- A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated.

2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: **Facing brick complying with ASTM C 216.**
 - 1. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C 67.
 - 2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 - 3. Size (Actual Dimensions): Match existing.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91.
- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- F. Colored Cement Products: Packaged blend made from **portland cement and hydrated lime or masonry cement** and mortar pigments, all complying with specified requirements, and containing no other ingredients.
- G. Aggregate for Mortar: ASTM C 144.
 - 1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 2. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- H. Aggregate for Grout: ASTM C 404.
- I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- J. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.
- B. Masonry-Joint Reinforcement, General: ASTM A 951.
 - 1. Interior Walls: Mill-galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.187-inch diameter.
 - 4. Wire Size for Cross Rods: 0.187-inch diameter.
 - 5. Wire Size for Veneer Ties: 0.187-inch diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 7. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.
- C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
- D. Masonry-Joint Reinforcement for Multiwythe Masonry:
 - 1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches wide, plus one side rod at each wythe of masonry 4 inches wide or less.

2.6 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82, with ASTM A 153, Class B-2 coating.
 - 2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
 - 1. Wire: Fabricate from 1/4-inch- diameter, hot-dip galvanized-steel wire.
- D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized-steel wire.
 - 2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, hot-dip galvanized-steel wire.
- E. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
 - 1. Corrosion Protection: **Epoxy coating 0.020 inch thick.**
- F. Veneer Anchors:

1. Tie section: Triangular-shaped wire tie, sized to accommodate 3" rigid insulation and extend within 1 inch of masonry face, made as detailed from 0.187-inch-diameter, hot-dip galvanized steel wire.
 - a. Available Manufacturer or an approved equal: Wire-Bond; MasonPro ABV3035.
2. Concrete/CMU Expansion Pins.
 - a. Available Manufacturer or an approved equal: Powers; Zamac Hammer Screw.

2.7 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as follows:
 1. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 2. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
- B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:
 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 1. Drainage Media: Mortar Net Solutions; MortarNet 1" by 10" tall width.

2.9 MASONRY-CELL FILL

- A. Loose-Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).
- B. Lightweight-Aggregate Fill: ASTM C 331/C 331M.

2.10 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
- C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Mix to match Architect's sample.
 - 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, Table 1.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.2 TOLERANCES

- A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- D. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.5 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together **as follows**:
 - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
 - 2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use **[ladder-type reinforcement extending across both wythes] [tab-type reinforcement]**.
 - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement **[with continuous horizontal wire in facing wythe attached to ties]**.
- B. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.
- C. Collar Joints in Clay Tile Masonry: After each course is laid, fill the vertical, longitudinal joint between wythes solidly with mortar at **[exterior walls, except cavity walls] [, and] [interior walls and partitions]**.
- D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
- E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
 - 1. Provide individual metal ties not more than 16 inches o.c.

3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together **[using one of the following methods] [as follows]**:
 - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of

openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use [**ladder-type reinforcement extending across both wythes**] [**tab-type reinforcement**].
 - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement[**with continuous horizontal wire in facing wythe attached to ties**].
 - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement[**with continuous horizontal wire in facing wythe attached to ties**] to allow for differential movement regardless of whether bed joints align.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

3.7 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 1. Space reinforcement not more than 16 inches o.c.
 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
 1. Provide an open space not less than **1/2 inch** wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.9 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 3. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
 - 1. Use specified weep/cavity vent products to form weep holes.
 - 2. Space weep holes 24 inches o.c. unless otherwise indicated.
 - 3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
- D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.10 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.11 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 3. Protect adjacent surfaces from contact with cleaner.
 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 042000

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Concrete masonry units.
 2. Decorative concrete masonry units.
 3. Pre-faced concrete masonry units.
 4. Mortar and grout.
 5. Steel reinforcing bars.
 6. Masonry-joint reinforcement.
 7. Embedded flashing.
 8. Miscellaneous masonry accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection:
1. Decorative CMUs, in the form of small-scale units.
 2. Colored mortar.
 3. Weep holes/vents.
- C. Material Certificates: For each type and size of the following:
1. Masonry units – Include data on material properties.
 2. Integral water repellent used in CMUs.
 3. Reinforcing bars.
 4. Joint reinforcement.
 5. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1.3 QUALITY ASSURANCE

- A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects.
1. Build sample panels for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness. Mockup may be used in construction only with the approval of the Owner's Representative.
 2. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by DMVA Project Manager in writing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.5 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. 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 from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
 - a. Available Products:
 - 1) Addiment Incorporated; Block Plus W-10.
 - 2) Grace Construction Products, a unit of W. R. Grace & Co.; Dry-Block System.
 - 3) Master Builders Solutions, BASF; MasterPel 240.
- C. CMUs: ASTM C 90.
 - 1. Density Classification: Normal weight.
 - 2. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
- D. Concrete Building Brick: ASTM C 55.
1. Density Classification: Normal weight.
- E. Decorative CMUs: ASTM C 90.
1. Density Classification: Normal weight.
 2. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
 3. Pattern and Texture: Match Architect's sample.
 - a. Standard pattern, split-face finish.
 4. Colors: Match Architect's samples.

2.4 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- E. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- F. Aggregate for Grout: ASTM C 404.
- G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

H. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Available Products:

- a. Heckman Building Products Inc.; No. 376 Rebar Positioner.
- b. Hohmann & Barnard, Inc.; RB or RB Twin Rebar Positioner.
- c. Wire-Bond; Figure 8 Rebar Positioners.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951.

1. Interior Walls: Mill-galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Wire Size for Veneer Ties: 0.187-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
8. Single-Wythe Masonry: Ladder type with single pair of side rods.
9. Multi-Wythe Masonry: Ladder type with one side rod at each face shell of hollow masonry units more than 4" in width, plus one side rod at each wythe of masonry 4" or less in width.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82, with ASTM A 153, Class B-2 coating.

C. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

D. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.

E. Veneer Anchors:

1. Tie section: Triangular-shaped wire tie, sized to accommodate 2" rigid insulation and extend within 1 inch of masonry face, made as detailed from 0.187-inch-diameter, hot-dip galvanized steel wire.
 - a. Available Manufacturer or an approved equal: Wire-Bond; MasonPro ABV3035.
2. Concrete/CMU Expansion Pins.

- a. Available Manufacturer or an approved equal: Powers; Zamac Hammer Screw.

2.8 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing: Use the following unless otherwise indicated:
 1. Copper-Laminated Flashing: 7-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
- B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following unless otherwise indicated/
 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8-inch less than depth of outer wythe; in color selected from manufacturer's standard.
 2. Drainage Media: Mortar Net Solutions; MortarNet 1" by 10" tall width.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 1. For masonry below grade or in contact with earth, use Type S.
 2. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
- C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 1. Pigments shall not exceed 10 percent of portland cement by weight.
 2. Mix to match Architect's sample.

3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, Table 1.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

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 the Work.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Do not wet concrete masonry units.
- B. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- C. Build chases and recesses to accommodate items specified in this and other Sections.
- D. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- E. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.

3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY

- A. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

3.8 CAVITY WALLS

- A. Provide an open space as indicated on DRAWINGS between veneer and existing masonry.
- B. Apply air barriers to face of backup wythe to comply with Section 072700, AIR BARRIERS.
- C. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.

- D. Provide weep holes in exterior wythe of cavity wall located immediately above ledges and flashing, spaced 16 inches o.c., unless otherwise indicated.

3.9 CAVITY WALL INSULATION

- A. Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown. Fills all cracks and open gaps in insulation with crack sealer compatible with insulation and masonry. See Section 072100, THERMAL INSULATION.

3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

3.11 LINTELS

- A. Install steel lintels where indicated. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels. For hollow concrete masonry unit walls, use specially formed U-shaped lintel units with reinforcement bars placed as shown filled with coarse grout.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.12 FLASHING

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
- B. Install flashing as follows unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 3. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
 4. Install weep holes in head joints in exterior wythe of first course of masonry immediately above embedded flashing and as follows:
 - a. Use specified weep/vent products to form weep holes.
 - b. Space weep holes 32 inches o.c. unless otherwise indicated.
 - c. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

- C. Place cavity drainage material in cavities as indicated.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.13 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

END OF SECTION 042200

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Miscellaneous steel trim.
 - 4. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

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

1.5 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240 or ASTM A 666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Rolled-Steel Floor Plate: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- G. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- H. Steel Pipe: ASTM A 53, Standard Weight (Schedule 40) unless otherwise indicated.
- I. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
 - 2. Material: Galvanized steel, ASTM A 653, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness.
- J. Cast Iron: Either gray iron, ASTM A 48, or malleable iron, ASTM A 47, unless otherwise indicated.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1 or Group 2.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in

concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

- F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.3 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3500 psi.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports at all exterior and high-moisture locations, and elsewhere as indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.6 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

- C. Galvanize and prime exterior miscellaneous steel trim.

2.7 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Prime plates with zinc-rich primer.

2.8 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.

2.9 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153 for steel and iron hardware and with ASTM A 123 for other steel and iron products.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

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

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Framing with dimension lumber.
 2. Framing with engineered wood products.
 3. Wood blocking and nailers.
 4. Wood furring.

1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable design stresses, as published by manufacturer, shall 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.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

2.4 DIMENSION LUMBER FRAMING

- A. Construction or No. 2 grade.
 1. Species:
 - a. Southern pine or mixed southern pine; SPIB.
 - b. Northern species; NLGA.
 - c. Eastern softwoods; NeLMA.
 - d. Western woods; WCLIB or WHPA.

2.5 LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Furring.
 - 5. Grounds.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 - 2. Eastern softwoods; No. 2 Common grade; NeLMA.
 - 3. Northern species; No. 2 Common grade; NLGA.
 - 4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.6 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

2.7 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- C. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

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

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. ICC-ES evaluation report for fastener.

END OF SECTION 061000

SECTION 062023 - INTERIOR FINISH CARPENTRY**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior trim.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.

1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
- B. Samples for Selection: For each type of product involving selection of colors, profiles, or textures.

1.3 DELIVERY, STORAGE, AND HANDLING

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

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20.

2.2 INTERIOR TRIM

- A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; C Select (Choice); NeLMA, NLGA, or WWPA.
2. Species and Grade: Douglas fir-larch or Douglas fir south, Superior or C & Btr finish; NLGA, WCLIB, or WWPA.
3. Species and Grade: Southern pine, C & Btr finish; SPIB.
4. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
5. Finger Jointing: Allowed.
6. Face Surface: Surfaced (smooth).

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- C. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

2.4 FABRICATION

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION, GENERAL

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

3.4 STANDING AND RUNNING TRIM INSTALLATION

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

3.5 ADJUSTING

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

3.6 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.7 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Extruded polystyrene foam-plastic board.
 2. Glass-fiber blanket.
 3. Loose fill insulation.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards."
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv Corporation.
 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 3. Thickness: As indicated on Drawings.
- C. Extruded Polystyrene Board, Type VI: ASTM C 578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv Corporation.
 - e. Soprema, Inc.
 2. Thickness: As indicated on Drawings.

2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation.
 - b. Guardian Building Products, Inc.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Knauf Insulation.
 - e. Owens Corning.

2.3 LOOSE-FILL INSULATION

- A. Cellulosic-Fiber Loose-Fill Insulation: ASTM C 739, chemically treated for flame-resistance, processing, and handling characteristics.
- B. Glass-Fiber Loose-Fill Insulation: ASTM C 764, Type I for pneumatic application or Type II for poured application; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

2.4 VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, 6-mil- thick sheet, with maximum permeance rating of 0.1 perm.

2.5 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
- D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."
 - 2. Coordinate insulation installation with air barriers specified in section 072700 "Air Barriers".

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
- B. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
 - 1. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."

3.6 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 072100

SECTION 072700 - AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes providing and installing one of the following air barriers:
 - 1. Fluid-applied, vapor-retarding membrane air barriers.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 VAPOR-RETARDING MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.
 - 1. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Maximum 0.1 perm; ASTM E 96.
 - c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.

2.3 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- C. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.
- D. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- B. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- C. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- E. For self-adhering sheet barriers systems, prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

3.2 FLUID APPLIED BARRIER INSTALLATION

- A. General: Install fluid-applied membrane air-barrier and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install air-barrier assembly on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of air barrier to substrate with termination mastic.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transitions and flashing so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal air-barrier assembly around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier.

- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams. Slit and flatten fishmouths and blisters. Extend patches 6 inches beyond repaired areas.
- K. Fluid-Applied Membrane Material: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
 - 1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil dry film thickness, applied in one or more equal coats.
- L. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- M. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
 - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Remove masking materials after installation.

END OF SECTION 072700

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof curbs.
 - 2. Pipe portals.
 - 3. Preformed flashing sleeves.
 - 4. Roof walkways.

1.2 COORDINATION

- A. Coordinate layout and installation of roof accessories with interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
 - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.
- D. Certified statement from Firestone stating that existing roof warranty has not been affected by Work performed under this Section.
 - 1. Existing Warranty: **Firestone Red Shield Roofing Limited Warranty No. RO098509.**

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded

or mechanically fastened and sealed corner joints and integrally formed deck-mounting flange at perimeter bottom.

- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.
 - 1. Finish: Mill phosphatized.
- D. Construction:
 - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
 - 3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
 - 5. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
 - 6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 7. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
 - 8. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
 - 9. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 PIPE PORTALS

- A. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.

2.4 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted metal collar.
 - 1. Metal: Aluminum sheet, 0.063 inch thick.
 - 2. Diameter: As indicated.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
 - 1. Metal: Aluminum sheet, 0.063 inch.
 - 2. Height: 7 inches.
 - 3. Diameter: As indicated on Drawings.

2.5 ROOF WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.
- F. Roof Walkway Installation:
 - 1. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.
- G. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- B. Clean exposed surfaces according to manufacturer's written instructions.
- C. Clean off excess sealants.

- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
- C. Product test reports.
- D. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A/D Fire Protection Systems Inc.
 - b. Grace Construction Products.
 - c. Hilti, Inc.
 - d. Johns Manville.
 - e. Nelson Firestop Products.
 - f. NUCO Inc.
 - g. Passive Fire Protection Partners.

- h. RectorSeal Corporation.
 - i. Specified Technologies Inc.
 - j. 3M Fire Protection Products.
 - k. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - l. USG Corporation.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
- 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
- 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
- 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
- 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

PART 2 - PRODUCTS

2.1 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A/D Fire Protection Systems Inc.
 - b. Grace Construction Products.
 - c. Hilti, Inc.
 - d. Johns Manville.
 - e. Nelson Firestop Products.
 - f. NUCO Inc.
 - g. Passive Fire Protection Partners.
 - h. RectorSeal Corporation.
 - i. Specified Technologies Inc.
 - j. 3M Fire Protection Products.
 - k. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - l. USG Corporation.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required.

Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- D. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Nonstaining silicone joint sealants.
 2. Urethane joint sealants.
 3. Mildew-resistant joint sealants.
 4. Butyl Rubber joint sealants.
 5. Latex joint sealants.

1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.
- D. Special warranties.

1.3 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Design Professional from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. **JS#1** - Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Joint Locations:
 - a. Exterior Construction joints in cast-in-place concrete.
 - b. Exterior Control and expansion joints in unit masonry.

- c. Exterior at Windows and door perimeters.
- d. Other joints as indicated on Drawings.
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 756 SMS or 795.
 - b. GE Construction Sealants; SilPruf NB.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 295 FPS NB.
 - d. Pecora Corporation; 864NST, 895NST, or 898NST.
 - e. Tremco Incorporated; Spectrem 2 or Spectrem 3.

2.3 URETHANE JOINT SEALANTS

- A. **JS #2** - Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Joint Locations:
 - a. Interior Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Interior Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry walls and partitions.
 - d. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC, Building Systems; Sonalastic TX1.
 - b. Bostik, Inc.; Chem-Calk GPS1, 900, 915, 916, 2000.
 - c. ER Systems, an ITW Company; Pacific Polymers Elasto-Thane 230 MP.
 - d. Pecora Corporation; Dynatrol I-XL.
 - e. Polymeric Systems, Inc.; Flexiprene 1000.
 - f. Schnee-Morehead, Inc., an ITW company; Permthane SM7108.
 - g. Sherwin-Williams Company (The); Stampede-1 or Stampede-TX.
 - h. Sika Corporation U.S.; Sikaflex Textured Sealant.
 - i. Tremco Incorporated; Dymonic.
- B. **JS #3** - Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
 1. Joint Locations:
 - a. Exterior Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Interior Isolation joints in cast-in-place concrete slabs.
 - c. Control and expansion joints in tile flooring.
 - d. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC, Building Systems; Sonalastic SL 1.
 - b. Pecora Corporation; NR-201.
 - c. Polymeric Systems, Inc.; Flexiprene 952.
 - d. Schnee-Morehead, Inc.; an ITW company; Permthane SM7101.
 - e. Sherwin-Williams Company (The); Stampede 1SL.

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

- B. **JS #4** - Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on the drawings.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 786-M White.
 - b. GE Construction Sealants; SCS1700 Sanitary.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
 - d. Soudal USA; RTV GP.
 - e. Tremco Incorporated; Tremsil 200.

2.5 BUTYL JOINT SEALANTS

- A. **JS #5** - Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
1. Joint Locations:
 - a. At exterior door thresholds
 - b. Aluminum thresholds.
 - c. Sill plates.
 - d. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; Chem-Calk 300.
 - b. Pecora Corporation; BC-158.
 - c. Tremco; Butyl Sealant.

2.6 LATEX JOINT SEALANTS

- A. **JS #6** - Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC, Building Systems; Sonolac.
 - b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600 or Bondaflex Sil-A 700.
 - c. Pecora Corporation; AC-20.
 - d. Sherwin-Williams Company (The); 850A, 950A or PowerHouse.
 - e. Tremco Incorporated; Tremflex 834.

2.7 JOINT-SEALANT BACKING

- A. General – Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal work.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amweld International, LLC.
 - 2. Ceco Door Products; an Assa Abloy Group company.
 - 3. Curries Company; an Assa Abloy Group company.
 - 4. Mesker Door Inc.
 - 5. Steelcraft; an Ingersoll-Rand company.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 INTERIOR DOORS AND FRAMES

- A. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.
 1. Physical Performance: Level B according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (18 gauge).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard.
 3. Frames:
 - a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch (16 gauge).
 - b. Construction: Face welded.
 4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.
- F. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
- I. Glazing: Pre-glaze units at the factory where possible and practical for applications indicated. Comply with AAMA 101-97 and the following.
 1. Interior Doors (Fire Resistive Safety Glass).
 - a. ¼" clear float glass meeting applicable requirements of Act 273 of the State of Michigan Public Acts of 1972, regarding safe glazing, to ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials..
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 1. Fire Door Cores: As required to provide fire-protection ratings indicated.
 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:

- a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
- 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
- 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.8 ACCESSORIES

- A. Louvers: Provide sightproof louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.
 - 1. Fire-Rated Automatic Louvers: Movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated. Basis-of-Design is **Activar fire-rated 1900 louver with security grille: 1900ASG** or an approved equivalent.
- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.

- f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- C. Glazing: Wired glass for fire doors shall be installed in compliance with the requirements of NFPA 80 revised..
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Field finish doors in accordance with Section 099100 "Painting".

END OF SECTION 081113

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of access door and frame and for each finish specified.
- C. Product Schedule: For access doors and frames.

1.3 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors and frames needed to gain access to concealed piping, mechanical, or other concealed work, and indicate in the "Product Schedule".

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges:
 - 1. Basis of Design: Subject to compliance with requirements, provide **Acudor UF-5000 Universal Flush** wall access doors or a comparable product by one of the following:
 - a. Acudor Products Inc.
 - b. Bar-Co, Inc. Div., Alfab, Inc.
 - c. Babcock Davis
 - d. Cendrex, Inc.
 - e. Cesco Products
 - f. Cierra Products
 - g. Jensen Industries.
 - h. Karp Associates, Inc.
 - i. Larsen's Manufacturing Co.
 - j. MIFAB Manufacturing, Inc.
 - k. Nystrom, Inc.
 - l. ProFlo.
 - 2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
 - 3. Locations: Wall and Ceiling.
 - 4. Door Size: 24" x 24" and 18" x 18" Ceiling and 12" x 12" Wall as needed.

5. Uncoated Steel Sheet for Door: Nominal 14 gauge, factory finished prime coat of white alkyd baked enamel.
6. Frame Material: Same material and finish as door, 16 gauge.
7. Latch and Lock: Cam latch, screwdriver operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Basis of Design: Subject to compliance with requirements, provide **MIFAB MPFR Series 1 ½ hour** single leaf fire rated access doors or a comparable product by one of the following:
 - a. Acudor Products Inc.
 - b. Babcock Davis.
 - c. Bar-Co, Inc. Div., Alfab, Inc.
 - d. Cendrex, Inc.
 - e. Cesco Products
 - f. Cierra Products
 - g. Jensen Industries.
 - h. Karp Associates, Inc.
 - i. Larsen's Manufacturing Co.
 - j. MIFAB Manufacturing, Inc.
 - k. Nystrom, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
3. Locations: ceilings.
4. Door Size: 24" x 36".
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Uncoated Steel Sheet for Door: Nominal 16 gauge, factory finished.
7. Frame Material: Same material and finish as door, 16 gauge.
8. Latch and Lock: Self-latching door hardware, Cylinder lock and key.

B. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Basis of Design: Subject to compliance with requirements, provide draft stop door **Cendrex DRD-60** single leaf fire rated access doors or a comparable product by one of the following:
 - a. Acudor Products Inc.
 - b. Babcock Davis.
 - c. Bar-Co, Inc. Div., Alfab, Inc.
 - d. Cendrex, Inc.
 - e. Cesco Products
 - f. Cierra Products
 - g. Jensen Industries.
 - h. Karp Associates, Inc.
 - i. Larsen's Manufacturing Co.
 - j. MIFAB Manufacturing, Inc.
 - k. Nystrom, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
3. Locations: Draft stops.
4. Door Size: 22" x 30".
5. Fire-Resistance Rating: Not less than that of adjacent construction.

6. Uncoated Steel Sheet for Door: Nominal 16 gauge, factory finished.
7. Frame Material: Same material and finish as door, 16 gauge.

C. Latch and Lock: Self-latching door hardware.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879, with cold-rolled steel sheet substrate complying with ASTM A 1008, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- E. Frame Anchors: Same material as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153 or ASTM F 2329.

2.5 FABRICATION

- A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- C. Latch and Lock Hardware:
 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 2. Keys: Furnish two keys per lock and key all locks alike.

2.6 FINISHES

- A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.
 - a. Color: As selected by Architect from full range of industry colors.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 087100 - DOOR HARDWARE**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes:
1. Mechanical door hardware for the following:
 - a. Swinging doors.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings.
 2. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
- C. Keying Schedule:
1. The Contractor shall coordinate the Keys and Cores with the Project Manager and the Key Coordinator at Lansing RFSC. The keys and cores will be made and stamped following Detroit Light Guard's keying system.
- D. Submit to General Contractor and DMVA Project Manager, the factory order acknowledgement numbers for the various hardware items to be used on the project. The factory order acknowledgement numbers shall help to facilitate and expedite any service that may be required on a particular hardware item. General Contractor/Construction Manager shall keep these order acknowledgement numbers on file in the construction trailer.
- E. Qualification Data: For Supplier, Architectural Consultant and Installer.
- F. Warranty: Special warranty specified in this Section.
- G. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware schedule.

1.3 QUALITY ASSURANCE

- A. **Installer Qualifications:** Provide a competent hardware installer with at least five years' experience installing commercial grade hardware.
- B. **Supplier Qualifications:** A recognized architectural finish hardware installer with warehousing facilities within a 100 mile radius of the project site and a distributor of all products and continuously in business for at least five years.
- C. **Source Limitations:** Obtain each type of door hardware from a single manufacturer.
- D. **Fire-Rated Door Assemblies:** Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- E. **Means of Egress Doors:** Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- F. **Accessibility Requirements:** Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design for door hardware on doors in an accessible route.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 - 4. Closers: Adjust door and gate closer sweep periods so that, from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.
 - 5. Spring Hinges: Adjust door and gate spring hinges so that, from an open position of 70 degrees, the time required to move the door to the closed position is 1.5 seconds minimum.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Coordinated delivery of keys and permanent cores too directly to Owner by registered mail or overnight package service from manufacturer.

1.5 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products. If dimension requirements are not included or implied by the product number selected as basis of design, then the dimensions will be supplied based on manufacturer's written literature for recommended product sizing for heavy use.
 2. Furnish and provide all necessary reinforcements, brackets, fasteners, spacers and fillers in order to provide complete and functioning openings as intended even if those items are not indicated in the hardware schedule.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

- A. Hinges: BHMA A156.1.
1. **H1** – Equal to **Hager BB1168** for interior/exterior heavy weight hinges.
 - a. Sizes shall be as per manufacturer recommendations for door size and weights, unless otherwise specified. All doors shall have ball bearing hinges.
 - 1) Door widths 3'-0" or less shall use standard weight (.134") hinges.
 - 2) Door widths over 3'-0" shall use heavy weight (.180") hinges, unless otherwise specified.
 - 3) Exterior door hinges shall be non-ferrous material.
 - b. Number of Hinges – Provide number of hinges indicated but not less than 3 hinges per door leaf on doors 90" or less in height and one additional hinges for each 30" of additional height.
 - c. Templates – Provide only template produced units.
 - d. Screws – Finish to match hinges.
 - e. Hinge Pings – Provide steel hinge pins for steel hinges; stainless steel pins for non-ferrous hinges; non-removable pins (NRP) for exterior doors; NRP hinges for out-swing corridor doors; non-rising pins for interior doors.
 - f. Tips – Flat button and matching plug, finished to match leaves.
 - g. Finish – 626.

2.3 MECHANICAL LOCKS AND LATCHES

A. Bored and Preamsembled Locks & Latches, BHMA A156.2.

**If the inside lockset lever is freewheeling (never fixed) then when the inside lever is rotated, it must unlock the outside lever in all functions except D Storeroom. If the submitted lockset manufacturer cannot follow this rule, this manufacturer will not be approved.

1. Type **L1 – Best**, or must be able to accept a Best Cylinder, heavy duty knob cylinder.
 - a. **93K** – 2 ¾” backset.
 - b. **7** – 7 pin core housing.
 - c. **AB** – Function; Entrance (F81).
 - d. **15** – Lever style, contour angle return.
 - e. **D** - Rose style, 3 ½” convex.
 - f. **STK** – Strike, 2 ¾” ANSI.
 - g. **626** – Finish, satin chrome plated.
 - h. Equal to Entry/ Office GT 116 PHL 234 ASA SFL 26D PDQ.
2. Type **L2 – Best**, or must be able to accept a Best Cylinder.
 - a. **93K** – 2 ¾” backset
 - b. **7** – 7 pin core housing.
 - c. **D** – Function; Storeroom (F86).
 - d. **15** – Lever style, contour angle return.
 - e. **D** - Rose style, 3 ½” convex.
 - f. **STK** – Strike, 2 ¾” ANSI.
 - g. **626** – Finish, satin chrome plated.
 - h. Equal to Storeroom GT 115 PHL 234 ASA SFL 26D PDQ.
3. Type **L3 – Best**, or must be able to accept a Best Cylinder.
 - a. **93K** – 2 ¾” backset.
 - b. **7** – 7 pin core housing.
 - c. **R** – Function; Classroom (F84).
 - d. **15** – Lever style, contour angle return.
 - e. **D** – Rose style, 3 ½” convex.
 - f. **STK** – Strike, 2 ¾” ANSI.
 - g. **626** – Finish, satin chrome plated.
 - h. Equal to Classroom GT 148 PHL 234 ASA SFL 26D PDQ.
4. Type **L4 – Best**, or must be able to accept a Best Cylinder.
 - a. **93K** – 2 ¾” backset.
 - b. **N** – Function; Passage (F75).
 - c. **15** – Lever style, contour angle return.
 - d. **D** – Rose style, 3 ½” convex.
 - e. **STK** – Strike, 2 ¾” ANSI.
 - f. **626** – Finish, satin chrome plated.
 - g. Equal to Passage GT 126 PHL 234 ASA 26D PDQ.
5. Type **L5 – PDQ**, or must be able to accept a Best Cylinder.
 - a. Mortise Lock.
 - b. Comply with ANSI A156.13, Grade 1 criteria for mortise locks.
 - c. Function: Mechanical and Electric functions Indicated in the hardware sets.
 - d. Trim: Stainless Steel / Philadelphia sectional lever-type, equal to PDQ.
 - e. Lockset case shall be non-handed and have three-piece latches.
 - f. Equal to Privacy Set w/ Indicator MR 236 PJSJ SFL 32D PDQ.
 - 1) Privacy Setw/ IndicatorMR 236 PJSJ.
 - 2) SFIC Mortise Cylinder Housing I5307.

- 3) Indicator outside – (Locked/Unlocked).

2.4 AUXILIARY LOCKS

- A. Auxiliary Locks & Associated Products, BHMA A156.5.
 1. **TB1** Tubular Deadbolt - **Best**, or must be able to accept a Best Cylinder.
 - a. 83T – 2 ¾" backset.
 - b. 7 – 7 pin housing.
 - c. K – Turnknob (ANSI E2151, Fed 181K); key outside, knob inside.
 - d. STK standard dead bolt.
 - e. 626 - Finish, satin chrome plated.

2.5 EXIT DEVICES

1. General:
 - a. Comply with ANSI A156.3, Grade 1, Types 1, 4, and 28 criteria for products supplied.
 - b. At fire doors:
 - 1) Provide UL or FM label on exit device indicating "Fire Exit Hardware", where appropriate.
2. **PED1** - Panic Exit Device - Equal to **PDQ 6300R** series exit device.
 - a. Panic Device 6300R CD (08)
 - b. Classroom Trim 6W 08 BSN SFL.
 - c. SFIC Mortise Cylinder Housing I5307 (CD)
 - d. 630 finish, Satin Stainless Steel (US32D).

2.6 MANUAL FLUSH BOLTS

- A. Flush Bolts.
 1. **FB** Flush Bolts - Extension Flush Bolts equal to **IVES 458**, UL listed for use on all types of labeled metal fire doors; to fit door and frame preparation to ANSI A115.4; standard length of rod is 12"; Extruded brass plate, brass slide, and bolt head; US26D finish. Install at top and bottom of non-active door LHR.

2.7 AUXILIARY ITEMS

- A. Auxiliary Hardware, BHMA A156.16.
 1. **WB** Wall Bumpers – Equal to **Rockwood 405**, solid forged brass housing, concave rubber insert bumper, 2 7/16" D x ¾" projection, ANSI L12251, 626 finish.
 2. **SH1** Door Stop and Holder Heavy Duty – Equal to **IVES 445 or 449**, solid brass, 626 finish.
 3. **FS1** Floor Stop with rubber bumper equal to **Rockwood 442** Cast Brass.
 4. **WS Rockwood 487** heavy duty wall stop, US626 finish.

2.8 LOCK CYLINDERS AND KEYING

- A. General:
 1. Meet with Owner and Design Professional to finalize keying requirements and obtain final written instructions.
 2. Owner shall install all final cores.
 3. Turn over existing cores and cylinders to DMVA Locksmith designated.

- B. Cylinders:
1. Type: Mortise, or rim-type as required by function of locking device.
 2. Provide screw on cams or tail piece as required.
 3. Construct lock cylinder parts from brass/bronze, stainless steel or nickel silver.
 4. Provide solid machined cylinder rings with tension spring to resist wrenching of cylinder. Length, finish and size as required.
 5. Provide cylinder(s) as required by function for each locking device.
- C. System:
1. Provide BEST cylinders with cores keyed to owners Best IC, 7-pin great grand master key system.
 - a. Furnish construction cores and keys for all cylinders.
 2. Keying:
 - a. Deliver keys and final cores to the hardware installation Contractor for final installation, when directed by the Owner.
 - b. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
 - c. Key material: Nickel silver.
 - d. Key quantity:
 - 1) Three (3) change keys for each lock;
 - 2) Five (5) master keys for each master system;
 - 3) Block out blades -keying directed by owner.

2.9 PULL/PUSH HARDWARE

- A. Pull/Push Hardware Plates; 626 finish.
1. **PS1, Push** equal to **Rockwood #70RC**, .050" wrought x 4" x 16", ANSI J301.
 2. **PU1, Pull** equal to **Rockwood 125X70C**, 1" half round, 4" x 16"; ANSI J405.
 3. **PU2, Pull** equal to **Rockwood 125**, 1" half round, 6" CTC, ANSI J401, thru bolts.

2.10 PROTECTIVE TRIM

- A. Protective Trim, BHMA A156.6.
1. Kick Plates.
 - a. Fabricate plates not more than 1 1/2" less than door width on hinge side and not more than 1/2" less than door width on application side. Stainless steel conforming to ANSI A156.6, .050" thickness, B4E (beveled 4 edges).
 - b. **K Kick Plates – Rockwood K1050 or IVES 8400 Series**, 18" high.
 - c. **A Armor Plates - Rockwood K1050 or IVES 8400 Series**, 34" high.

2.11 SURFACE CLOSERS

- A. Closers, Overhead, BHMA A156.4.
1. Provide parallel arms for all overhead closers, provide unit one size larger than recommended for use with standard arms depending on size of door, exposure to weather, and anticipated frequency of use.
 2. **C1 Push Side Units**, with hold open arm, shall have backcheck and keyvalve features. Degree of openings shall be the maximum possible without causing interference or damage to door or trim **equal to LCN 4110 Smoothee series**, with standard cover, 4110-

3077EDA extra duty arm, and 4110-30489EDA hold-open where applicable, heavy commercial, 10 year warranty, Satin Satin Chrome US26D plated finish on cover, arm, and fasteners.

3. **C2 Pull** Side Units same as C1 units except pull side configuration.
4. **C3** Same as C1 except *NO* Hold Open Feature.
5. **C4** Same as C2 except *NO* Hold Open Feature.

2.12 DOOR GASKETING

A. Door Gasketing Systems, BHMA A156.22.

1. Provide continuous head and jamb weather-stripping on exterior doors of type where flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
 - a. Extruded aluminum with color anodized finish as selected from manufacturer's standard color range, 0.062" minimum thickness of main walls and flanges, with pre-punched slotted holes for adjustment.
 - 1) **AS-1** Astragals.
 - a) **LG** Metal Astragal – Equal to **Hager 835S**, stainless steel, 5/32" x 1-5/8" x full height of door; exterior side of door, active door.

2.13 THRESHOLDS

A. Thresholds: BHMA A156.21.

1. **T1** –equal to **National Guard Products, Inc.**, 426, 6" wide x ½" height x .175" thickness x opening width, cut and notched to fit frames and stops. Aluminum anodized finish.
2. **T2** – marble threshold 4" wide will width of opening, matching existing.
3. **T3** – (carpet edge guard)...aluminum min 2" wide, minimum 5/8" wide fold. Anodized Aluminum finish. Hammered texture finish.)

2.14 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Use Manufacturer's Templates.
 3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 4. Reinforce substrate where necessary to assure proper attachment.
- D. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

END OF SECTION 087100

SECTION 088733 – DECORATIVE FILMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Decorative films.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - 2. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E903 - Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.

1.3 DEFINITIONS

- A. Visible Light Transmittance: The ratio of the amount of visible light (380-780 nm) that is allowed to pass through a glazing system to the amount of visible light falling on the glazing system. The value is expressed as a percentage.
- B. Diffuse Visible Light Reflectance (exterior): The percentage of visible light falling on a flat, non-mirrored surface that is neither transmitted nor absorbed but scattered backwardly at random angles from that surface. This value is also known as “non-specular reflectance”.
- C. Privacy Film Rating: This number, between 0 (clear) and 10 (opaque), represents the relative difficulty an observer has in identifying the nature and character of an object located on the opposite side of the window, with the observer and the object both located at least 2 feet from the pane upon which the product has been installed.
- D. Frost Series: These films have frosted and translucent finishes that ensure privacy without sacrificing natural light. They are ideal for commercial interior glazing applications such as office partitions or to meet interior design goals at a fraction of the cost of etched glass.
- E. Gradient Series: These films are intended to give graduated privacy while still allowing for a sense of openness. Partially block out views, selectively hide unattractive areas or add a fresh design element easily with this versatile series.
- F. Pattern Series: These films are scratch-resistant and offer a wide range of aesthetic solutions through varying levels of translucent and opaque whites with a simulated acid-etched appearance. These films also include a broad range of classic patterns.
- G. Texture Series: These films refract light and simulate the sparkle and clarity of a textured glass window. These translucent, flexible films are the perfect solution for hard-to-cover specialty windows.

- H. Specialty Series: These films mask light, add privacy, or give a pop of color to any space. Bold, graphic hues and distinctive designs enliven retail spaces and commercial properties. Unique combinations of specialty films allow for endless customizable possibilities.

1.4 PERFORMANCE REQUIREMENTS

- A. Scratch Resistance: Decorative films shall average less than 12 percent increase in haze when tested according to ASTM D1044 using a Teledyne Taber Abrader using CS10F Type III wheels each loaded to 0.5 kg for 100 cycles in a 70 percent vacuum.
- B. Surface Burning Characteristics: Provide films that have Flame Spread Index of 0 and Smoke Developed Index of 30 or less when tested in accordance with ASTM E84.
- C. Provide Decorative films that do not have a masking sheet.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of decorative film specified, two (2) samples, 12 inches square.
- C. Operation and Maintenance Data: Submit for decorative film to include in maintenance manuals.
- D. Warranty: Submit sample special warranty specified in this section.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that has a minimum of 5 years of documented experience manufacturing decorative films similar to that used for this project.
- B. Installer Qualifications: A firm that is authorized by decorative film manufacturer to install film in accordance with guidelines set forth by the manufacturer.
- C. Source Limitations: Obtain each type of decorative film from same manufacturer.
- D. Mock-ups: Build mock-ups to verify selections made under sample submittals and to evaluate surface preparation techniques and application workmanship.
 - 1. Approved mock-ups may become part of the completed work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle materials in manufacturer's protective packaging.
- B. Store and protect materials according to manufacturer's written recommendations to prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace films that fail within specified warranty period.
 - 1. Warranty Period: 5 years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for decorative films is based on LLumar® Decorative Films manufactured by Eastman Chemical Company: Performance Films, 575 Maryville Centre Drive, St. Louis, Missouri 63141; Telephone: 800-255-8627; Email address: commercialalerts@eastman.com; Web Site: www.llumar.com.

2.2 DECORATIVE FILMS

- A. Decorative Film: LLumar® NRM55PS4 Decorative Frost Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:
 - 1. % Visible Light Transmission: 62.
 - 2. % Diffuse Visible Light Reflectance (exterior): 36.
 - 3. Privacy Film Rating: 9.
 - 4. Thickness without Liner: 0.004 inches.
 - 5. Film Color: Glacier.

2.3 DECORATIVE FILM ACCESSORIES

- A. General: Provide accessories either manufactured by or acceptable to Decorative film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Pressure sensitive adhesive: This adhesive is activated by pressure and water. It is characterized by its permanently tacky nature and its installation ease.
- C. Cleaners, Primers, and Sealers: Types recommended by film manufacturer..

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements and for conditions affecting performance of Decorative film including glass that is broken, chipped, cracked, abraded, or damaged in any way.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates thoroughly prior to installation.

- C. Prepare substrates using methods recommended by film manufacturer to achieve the best results for the substrate under project conditions.
- D. Protect window frames and surrounding surfaces to prevent damage during installation.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Install film continuously, but not necessarily in one (1) continuous length. Install with no gaps or overlaps.
- C. If seamed, make seams non-overlapping.
- D. Do not remove release liner from film until just before each piece of film is cut and ready for installation.
- E. Custom cut to the glass with neat, square corners and edges to within 1/8-inch of the window frame.
- F. Remove air bubbles, blisters, and other defects. Be careful to remove "fingers" to eliminate any contamination or excess water pockets. It is crucial to remove as much water as possible during installation.
- G. A final squeegee pass over the entire pane using a Blue Max Blade™ with an extended handle design (or Thor's Hammer™) is recommended.

3.4 FIELD QUALITY CONTROL

- A. After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, wrinkles, banding, thin spots or pinholes.
- B. If installed film does not meet these criteria, remove and replace with new film.

3.5 CLEANING AND PROTECTION

- A. Remove excess mounting solution at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended by film manufacturer.
- C. Replace films that cannot be cleaned.
- D. Protect installed products until completion of project.
- E. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION 088733

SECTION 092216 - NON-STRUCTURAL METAL FRAMING**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Non-load-bearing steel framing systems for interior partitions.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.0329 inch (20 gage).
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.053 inch (16 gage).
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
1. Depth: 1-1/2 inches.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.0179 inch.
 - 2. Depth: As indicated on Drawings.
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to

terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.

1.2 SUBMITTALS

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

1.3 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum.
 - b. CertainTeed Corp.
 - c. Georgia-Pacific Gypsum LLC.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.

- g. Temple-Inland.
 - h. USG Corporation.
 - B. Gypsum Board, Type X: ASTM C 1396.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.
 - C. Impact-Resistant Gypsum Board: ASTM C 1629/C 1629M.
 - 1. Core: 5/8 inch, Type X.
 - 2. Surface Abrasion: Meets or exceeds Level 3 requirements.
 - 3. Surface Indentation: Meets or exceeds Level 1 requirements.
 - 4. Single-Drop Soft-Body Impact: Meets or exceeds Level 3 requirements.
 - 5. Hard-Body Impact: Meets or exceeds Level 3 requirements according to test in Annex A1.
 - 6. Long Edges: Tapered.
 - 7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - D. Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch, Type X.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- 2.4 TRIM ACCESSORIES
- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
- 2.5 JOINT TREATMENT MATERIALS
- A. General: Comply with ASTM C 475.
 - B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
- 2.6 AUXILIARY MATERIALS
- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
 - B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 - D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C 840.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16" of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- F. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- G. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- H. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- I. Attachment to Steel Framing – Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- J. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for acoustical tile.
 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099100 "Painting."
 4. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099100 "Painting."

3.2 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quarry tile.
 - 2. Porcelain tile.
 - 3. Glazed wall tile.
 - 4. Stone thresholds.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Stone thresholds.
- C. Qualification Data: For Installer.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer employs Ceramic Tile Education Foundation Certified Installers.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Ceramic Tile Type [CT-<#>]: [**Unglazed**] [**Glazed**] square-edged quarry tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - a. American Olean Corporation.
 - b. Dal-Tile Corporation.
 - c. Endicott Tile Ltd.; Endicott Clay Products Co.
 - d. Florida Brick & Clay Company Inc.
 - e. Interceramic.
 - f. Jeffrey Court Inc.
 - g. Metropolitan Ceramics.
 - h. Quarry Tile Co.
 - i. Seneca Tiles, Inc.
 - j. Sonoma Tilemakers.
 - k. Summitville Tiles, Inc.
 - l. Vitromex USA.
 2. Face Size: [3 by 3 inches] [4 by 4 inches] [6 by 3 inches] [6 by 6 inches] [8 by 3-7/8 inches] [8 by 8 inches] <Insert dimensions>.
 3. Thickness: [3/8 inch] [1/2 inch] [3/4 inch].
 4. Wearing Surface: [Nonabrasive, smooth] [Abrasive aggregate embedded in surface] <Insert description>.
 5. Dynamic Coefficient of Friction: Not less than 0.42.
 6. Finish: [Bright, opaque] [Bright, clear] [Mat, opaque] [Mat, clear] [Semimat, opaque] [Semimat, clear] [Vellum, opaque] [Vellum, clear] [Crystalline] <Insert description> glaze.
 7. Tile Color and Pattern: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and pattern>.
 8. Grout Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable [and matching characteristics of adjoining flat tile]. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base: Coved [with surface bullnose top edge], face size [6 by 6 inches] [8 by 3-7/8 inches] <Insert dimensions>.
 - b. Wainscot Cap: Surface bullnose, face size [6 by 6 inches] [8 by 3-7/8 inches] <Insert dimensions>.
- B. Ceramic Tile Type [CT-#]: [Unglazed] [Glazed] porcelain tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 2. Certification: Tile certified by the Porcelain Tile Certification Agency.
 3. Face Size: [3 by 3 inches] [4 by 4 inches] [6 by 6 inches] [7-3/4 by 3-7/8 inches] [7-7/8 by 7-7/8 inches] [11-13/16 by 11-13/16 inches] [165 by 333 mm] [200 by 250 mm] [250 by 250 mm] [165 by 333 mm] [333 by 333 mm] [400 by 400 mm] <Insert dimensions>.
 4. Face Size Variation: Rectified.
 5. Thickness: [1/4 inch] [3/8 inch] [1/2 inch].
 6. Face: [Plain with square or cushion edges] [Plain with square edges] [Plain with cushion edges] [Polished with square edges] [As indicated].
 7. Dynamic Coefficient of Friction: Not less than 0.42.

8. Tile Color, Glaze, and Pattern: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color, glaze, and pattern>.
 9. Grout Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
 10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[**and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cap: Surface bullnose, module size [same as adjoining flat tile] <Insert size>.
 - b. Wainscot Cap: Surface bullnose, module size [same as adjoining flat tile] <Insert size>.
 - c. External Corners: Surface bullnose, module size [same as adjoining flat tile] <Insert size>.
 - d. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.
- C. Ceramic Tile Type [CT-#>]: Glazed wall tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean Corporation.
 - c. Dal-Tile Corporation.
 - d. Jeffrey Court Inc.
 - e. Porcelanite.
 - f. Seneca Tiles, Inc.
 2. Module Size: [4-1/4 by 4-1/4 inches] [6 by 4-1/4 inches] [6 by 6 inches] [200 by 200 mm] [250 by 250 mm] [200 by 300 mm] <Insert dimensions>.
 3. Face Size Variation: Rectified.
 4. Thickness: 5/16 inch.
 5. Face: [Plain with modified square edges or cushion edges] [Plain with modified square edges] [Plain with cushion edges] [Pattern of design indicated, with manufacturer's standard edges].
 6. Finish: [Bright, opaque] [Bright, clear] [Mat, opaque] [Mat, clear] [Semimat, opaque] [Semimat, clear] [Vellum, opaque] [Vellum, clear] [Crystalline] <Insert description> glaze.
 7. Tile Color and Pattern: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and pattern>.
 8. Grout Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
 9. Mounting: Factory, back mounted.
 10. Mounting: PregROUTED sheets of tiles are factory assembled and grouted with manufacturer's standard white silicone rubber.
 11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable[**and matching characteristics of adjoining flat tile**]. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base: [Coved] [Straight], module size [4-1/4 by 4-1/4 inches] [6 by 6 inches] [6 by 3-3/4 inches] [6 by 2 inches] <Insert dimensions>.

- b. Wainscot Cap: [**Bullnose cap**] [**Surface bullnose**], module size [**4-1/4 by 4-1/4 inches**] [**6 by 6 inches**] [**6 by 2 inches**] <Insert dimensions>.
- c. External Corners: [**Bullnose**] [**Surface bullnose**], same size as adjoining flat tile.
- d. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of [**10**] [**12**] according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 - 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
- B. Dry-Set Portland Cement Mortar (Thinset): ANSI A118.1.
- C. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.

2.5 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7.

2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
- C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances

that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

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

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors in laundries.
 - c. Tile floors consisting of tiles 8 by 8 inches or larger.
 - d. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the

use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Quarry Tile: 1/4 inch.
 - 2. Glazed Wall Tile: 1/16 inch.
 - 3. Porcelain Tile: 1/4 inch.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
- J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- K. Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.
 - 4. Impact Clips: Equal to 2 percent of quantity installed.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- B. Acoustical Panel Standard: Comply with ASTM E 1264.

- C. Metal Suspension System Standard: Comply with ASTM C 635.
- D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Armstrong 2'x2' #756 Fissured Square Layin** or a comparable product by one of the following:
 - 1. U.S. Gypsum.
 - 2. Conweb.
 - 3. Gold Bond.

2.4 METAL SUSPENSION SYSTEM

- A. Provide manufacturer's standard direct-hung metal suspension system of type, structural classifications, color and finish to match existing system in place.
 - 1. Comply with applicable ASTM C 635 requirements. Attachment Devices - Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung. Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with a capability to sustain, without failure, loading equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties - Provide wires complying with following:
 - 1. Zinc-Coated Carbon-Steel Wire - ASTM A 641, Class 1 zinc coating, soft temper.
 - 2. Size - Select wire diameter so it's stress at 3 times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106" diameter.
- C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
- D. System shall be complete with supporting members, anchors, wall cornices, and adapters for light fixtures, plus incidental accessories required for a complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Carefully inspect installed work of other trades and verify such work is complete to the point where this installation may properly commence.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
 - 1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.
- C. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperature.
 - 5. Do not attach hangers to steel deck tabs or to steel roof deck. Attach hangers to structural members.
 - 6. Space hangers not more than 48" o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8" from ends of each member.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to a tolerance of 1/8" in 12'. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Space cross "T" members to match existing pattern and secure to main runners and wall angles as required.
- G. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as required to match existing.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions.

3.3 CLEANING

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

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

PART 2 - PRODUCTS

2.1 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 3. Flexco.
 - 4. Johnsonite; A Tarkett Company.
 - 5. Roppe Corporation, USA.
 - 6. VPI Corporation.
- B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
 - 1. Group: II (layered).
 - 2. Style and Location:
 - a. Style B, Cove.
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Outside Corners: Job formed or preformed.
- F. Inside Corners: Job formed or preformed.
- G. Colors and Patterns: As selected by DMVA from full range of industry colors.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Concrete Slab Primer - Nonstaining type as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 1. Apply two coat(s).
- C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl composition floor tile.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
- C. Samples: Full-size units of each color and pattern of floor tile required.
- D. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Biltrite.
 - 2. Armstrong World Industries, Inc.
 - 3. Congoleum Corporation.
 - 4. Mannington Mills, Inc.
- B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch.
- E. Size: 12 by 12 inches.
- F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

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

- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply two coat(s).
- C. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099100 - PAINTING

PART ONE - GENERAL

1.01 SUMMARY

- A. Provide surface preparation and field- or shop-painting indicated.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.
 - 2. Paint exposed surfaces, except where it is indicated that a surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically indicated to be excluded from painting, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, DMVA will select from standard colors and finishes available.
 - 3. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

1.02 SUBMITTALS

- A. Product data for each paint system specified, including color charts.
- B. Material List - Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classifications.
- C. Manufacturer's Information - Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
- D. Material Safety Data Sheets (MSDS's) - Submit one copy for each paint type. MSDS's do not constitute and are in addition to above paragraphs "A", "B", or "C" shop drawing submittals. MSDS's must be on site during paint application.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
- C. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

- D. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
- E. Maintain containers in clean condition, free of foreign materials and residue.
- F. Remove rags and waste from storage areas daily.

1.04 PROJECT CONDITIONS

- A. Apply paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F and 90 deg F.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

1.05 EXTRA STOCK

- A. Upon completion of work, deliver to Owner an extra stock of paint equaling 5%, but not less than one gallon, of each color used in each coating material used, with such extra stock tightly sealed in clearly labeled containers.

PART TWO - PRODUCTS

2.01 PAINT MATERIALS

- A. Material Compatibility:
 - 1. Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Material Quality – Provide manufacturer’s best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer’s product identification will not be acceptable.
- C. Proprietary Names – Use of manufacturer’s proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer’s material data and certificates of performance for review and approval of proposed substitutions.
 - 1. When submitting equivalent products by other manufacturers, Contractor retains responsibility for compatibility and the quality, durability, and integrity of the end product of applied products.
- D. Colors: Where colors are not specified the intent is to computer match the existing color and sheen of adjacent finishes. Where there is a noticeable difference in finish on a single wall, the whole wall shall be painted.

2.02 SCHEDULE OF PAINTING AND FINISHING – Subject to requirements and except where specifically noted, Basis of Design is Sherwin-Williams products or equal.

PAINTING

A. Interior Painting

1. Finish One
a. First Coat New and Existing Gypsum Board Ceiling
ULTRA-HIDE Vapor Barrier Latex Primer-Sealer.
b. Second Coat Pro-Mar 200 Latex Flat
c. Third Coat Pro-Mar 200 Latex Flat
2. Finish Two
a. First Coat New and Existing Gypsum Drywall
Prep Rite 200 Latex Primer
b. Second Coat Pro-Mar 200 Latex Egg shell
c. Third Coat Pro-Mar 200 Latex Egg Shell
3. Finish Three
a. First Coat New and Existing Gypsum Drywall/Plaster (Epoxy).
Prep Rite 200 Latex Primer
b. Second Coat Water Based Catalyzed Epoxy - Gloss
c. Third Coat Water Based Catalyzed Epoxy - Gloss
4. Finish Four
a. First Coat New and Existing Block Masonry
Pro-Mar Latex Block Filler
b. Second Coat Pro-Mar 200 Latex Gloss
c. Third Coat Pro-Mar 200 Latex Gloss
5. Finish Five
a. First Coat New and Existing Block masonry, (Epoxy)
Heavy Duty Block Filler
b. Second Coat Water Based Catalyzed Epoxy – Gloss
c. Third Coat Water Based Catalyzed Epoxy – Gloss
6. Finish Six
Interior Hollow Metal Doors & Frames, shop primed steel, i.e., structural framing, lintels, structural steel.
a. First Coat Acrylic Prime/Finish Touch-Up
b. Second Coat Pro-Mar 200 Latex Gloss Enamel
c. Third Coat Pro-Mar 200 Latex Gloss Enamel
7. Finish Seven
Exposed mechanical ductwork.
a. First Coat Pro Industrial Pro-Cryl Primer
b. Second Coat Pro Industrial WB Acrylic Dryfall
c. Third Coat Pro Industrial WB Acrylic Dryfall
8. Finish Eight
Exposed structural steel, handrail and stairs, I-Beam plates, tubing, lintels, radiators, plumbing, and mechanical.
a. First Coat KemKromik Universal Metal Primer
b. Second Coat Industrial Enamel Gloss
c. Third Coat Industrial Enamel Gloss

B. Exterior Painting

1. Finish Nine
a. First Coat Galvanized roof top steel I-beams & tubes, piping, lintels.
KemKromik Universal Metal Primer
b. Second Coat Industrial Enamel, Gloss
c. Third Coat Industrial Enamel, Gloss

PART THREE – EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
- B. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 1. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- C. Coordination of Work – Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify DMVA about anticipated problems when using the materials specified over substrates primed by others.

3.02 PREPARATION

- A. General – Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning – Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 - 2. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 3. Provide barrier coats over incompatible primers or remove and prime with compatible primer.
- C. Cementitious Materials – Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panels surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - 1. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - 2. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in paint manufacturer's written instructions.
 - 3. Clean concrete floors to be painted with a 5% solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
- D. Wood – Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand smooth surfaces exposed to view and dust off.
 - 1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - 2. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.

3. If transparent finish is required, backprime with spar varnish.
- E. Ferrous Metals – Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC’s recommendations.
1. Clean steel surfaces as recommended by paint system manufacturer and, depending on surface conditions, according to a combination of SSPC-SP No. 2 Thorough Hand Tool Cleaning, SSPC-SP No. 3 Thorough Power Tool Cleaning, or SSPC-SP No. 7 Brush Off Blast Cleaning.
 2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- F. Galvanized Surfaces – Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- G. Mechanical Ductwork - First perform a Copper Sulfate Test on Spiral Ductwork for paint readiness:
1. Mix one ounce of Copper Sulfate crystals with three pints of distilled water to make a 2% solution. Apply 1 drop of the 2% copper sulfate solution to the surface(s) in multiple areas. If a black spot develops within 5 seconds of contact, the surface(s) is ready for painting. If a black spot does not appear you will need to repeat this test after cleaning additional test areas/rinsing those areas/and allowing to dry first. Recommended cleaners will be #1 Great Lakes Laboratories Clean 'n Etch (1 part Clean 'n Etch with two parts water, follow manufacturer recommendations), #2 Powdered T.S.P. (per mixing and rinsing on label).
- H. Material Preparation – Mix and prepare paint materials according to manufacturer’s written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- I. Tinting – Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 APPLICATION

- A. General – Apply paint according to manufacturer’s written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paints, surface treatments, and finishes are indicated in the SCHEDULE OF PAINTING AND FINISHING in this Section and in the ROOM FINISH SCHEDULE on the Drawings.
 2. The term “exposed surfaces” includes areas visible when permanent or built-in fixtures, grilles, convectors covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 3. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 4. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 5. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 6. Finish doors on tops, bottoms, and side edges the same as both exterior faces.
 7. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

8. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 9. Sand lightly between each succeeding enamel or varnish coat.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Allow sufficient time between successive coats to permit proper drying in accordance with manufacturer's instructions. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- E. Minimum Coating Thickness – Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- F. Scheduling Painting – Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- G. Application Procedures – Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes – Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item, being painted.
 2. Rollers – Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment – Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- H. Mechanical items to be painted include, but are not limited to, the following:
1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.

7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- I. Electrical items to be painted include, but are not limited to, the following:
 - 1. Panel back boards.
 - 2. Electrical equipment that is indicated to have a factory-primed finish for field painting.
 - 3. Exposed conduit or raceway within finished areas.
 - J. Block Fillers – Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
 - K. Prime Coats – Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
 - L. Pigmented (Opaque) Finishes – Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
 - M. Transparent (Clear) Finishes – Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - 1. Provide satin finish for final coats.
 - N. Completed Work – Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
 - O. INSTALLATION OF REMOVED ITEMS - Following final painting and proper drying of each space or surface area, promptly install items removed for painting. Items lost shall be replaced at Contractor's expense.

3.04 CLEANING AND PROTECTION

- A. Cleanup – At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
- B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.
- C. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by DMVA.
- D. Provide “Wet Paint” signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
- E. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

END OF SECTION 099100

SECTION 101100 - VISUAL DISPLAY SURFACES

PART ONE GENERAL

1.01 SUMMARY

- A. Section Includes.
 - 1. Marker Boards.

1.02 SUBMITTALS

- A. Product Data – For product indicated.

PART TWO PRODUCTS

2.01 MARKER BOARD (14' X 4')

- A. Marker Board – Melamine surface, thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- B. Aluminum Trim - Manufacturers standard satin, anodized ASTM B 221, Alloy 6063, 0.062" thick aluminum for concealed mounting and snap-on trim as follows:
 - 1. Edge trim approximately 1 1/2" wide.
 - 2. Solid extruded.
- C. Accessories – Extruded aluminum chalktray at frame bottom, full length.
- D. Cleaning Instructions Plate - Provide instructions for markerboard cleaning on a metal plate fastened to bottom rail of perimeter frame.
- E. Available Manufacturers include, but are not limited to:
 - 1. AARCO Products, Inc.
 - 2. ADP/Lemco, Inc.
 - 3. Bangor Cork Company, Inc.
 - 4. Best-Rite Manufacturing.
 - 5. Claridge Products & Equipment, Inc.
 - 6. Egan Visual Inc.
 - 7. Ghent Manufacturing Inc.
 - 8. Marsh Industries, Inc.

PART THREE EXECUTION

3.01 INSTALLATION, GENERAL

- A. Install visual display surfaces in location indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide accessories necessary for a complete installation.
- B. Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board with fasteners at not more than 16" o.c. secure both top and bottom of boards to walls.
 - 1. Field-Applied aluminum Trim – Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24" o.c.

C. Remove protective film, if provided, and wipe surfaces clean.

END OF SECTION 101100

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Panel signs.
 - 2. Room-identification signs.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
 - 4. Show locations of electrical service connections.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.
- E. Sample warranty.
- F. Maintenance data.

1.3 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 ROOM IDENTIFICATION SIGN

- A. Engraved, unframed, signs of acrylic or ABS plastic with edges mechanically and smoothly finished as either beveled or bull nose. Edge color for plastic laminate may be either same as copy or same as background. Corners shall be square rounded. Engrave through the exposed face ply of the plastic laminate sheet to expose the contrasting core ply. Face ply shall be wood grain, core ply shall be white.

- B. See drawings for sign sizes and layout.
- C. Rooms shall be identified by Room Name and Room Number, see drawings.

2.3 PANEL-SIGN MATERIALS

- A. Acrylic Sheet: ASTM D 4802, Type UVF (UV filtering).
- B. Polycarbonate Sheet: Coated, mar-resistant, UV-stabilized polycarbonate, with coating on both sides.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Internally brace signs for stability and for securing fasteners.
 - 5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.
 - 1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
 - 2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
 - 3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
 - 4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
- C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

- D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and at a height of 5'-8" above finish floor, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
 - 1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101423

SECTION 102113 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes solid-plastic toilet compartments configured as indicated.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.
- C. Samples for each type of toilet compartment material indicated.

1.3 QUALITY ASSURANCE

- A. Comply with requirements in UFGS-10 21 13, "Toilet Compartments"

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Established Dimensions - Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1 for toilet compartments designated as accessible.

2.2 MANUFACTURER'S

- A. Basis-of-Design Product: Subject to compliance with requirements, General Partitions, Series 40 Polymer (HDPE) Floor Anchored/Overhead Braced Toilet Compartments or comparable product by one of the following:
 - 1. Columbia Partitions.
 - 2. Comtec Industries.

3. Scranton Products.
4. General Partitions.
5. Global Partitions.

- B. Finish and color shall be integral with panel construction; color to be selected from manufacturer's standard colors furnished with Shop Drawings.

2.3 MATERIALS

- A. Doors, panels and pilasters to be 1" thick with homogeneous color throughout, constructed from high density polyethylene (HDPE) resins, which are, waterproof non-absorbent and have a self-lubricating surface that resists markings from pens, pencils and other writing instruments.

2.4 FABRICATION

- A. Doors, panels and pilasters shall be 1" thick with uniformly machined edges.
- B. Doors and panels shall be 55" high and mounted at 14" above the finished floor.
- C. Doors and panels to have an extruded aluminum heat sink strip attached to the lower edge.
- D. Pilasters shall be 81-1/2" high. Pilasters shall include a mounting system comprised of 1/4" x 1" stainless steel mounting bar attached to the pilaster, having 3/8" zinc plated steel lag bolts Each mounting bar shall be secured to the building structure with 3/8" zinc plated steel studs. A shoe shall conceal each floor mounting, having an internal cross section conforming to the pilaster.
- E. Pilasters are overhead braced with an extruded anti-grip aluminum headrail.

2.5 HARDWARE AND ACCESSORIES

- A. Heavy-duty diecast (vault) zamac hinge shall have gravity-acting cams and are fabricated from a die cast aluminum alloy with a brushed finish and wrap around flanges. The cam is constructed from a 3/4" diameter nylon rod and a 3/8" stainless steel pin. Slide latch, strike/keeper and hinges are through-bolted onto doors and pilasters using stainless steel vandal-resistant through bolts. Hinges are easily adjusted at the jobsite to a full close or partially open position, as required. Keeper provides for emergency access into the stall by lifting up on the bottom of the door.
- B. Panel and pilaster brackets shall be as noted:
1. Aluminum stirrup brackets shall be 2" long made of heavy-duty anodized extruded aluminum (6063-T5 Alloy). Stirrup brackets shall be 1/8" thick and mounted with stainless steel, vandal-resistant screws. Panels shall be attached with stainless steel, vandal-resistant through bolts. The attachment of brackets to the adjacent wall construction shall be accomplished with 2 1/2" stainless steel vandal-resistant screws and plastic anchors.
- C. Pilaster shoes shall be stainless steel 5" high with a #4 satin finish. Pilaster shoes are anchored to the pilaster with #10 stainless steel, vandal-resistant screws. Optional: Plastic pilaster shoes shall be 5" high.

- D. Headrail shall be made of heavy-duty anodized extruded aluminum (6063-T5 alloy). Headrail is anti-grip and attaches to the top of the pilaster with stainless steel, tamper-resistant screws. Headrail is attached to the adjacent wall construction with a headrail bracket.
- E. Headrail brackets shall be made from a die cast aluminum alloy and shall be attached to the adjacent wall construction with 2 ½" stainless steel, tamper-resistant screws and plastic anchors.
- F. Coat Hooks - Manufacturer's standard unit, combination hook and rubber-tipped bumper, sized to prevent door hitting mounted accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
- B. Install compartment units rigid, straight, plumb, level, and true-to-line.
- C. Components shall be secured as detailed on approved shop drawings. Secure panels to walls with not less than 2 stirrup brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchorages occur in masonry or tile joints.
- D. Secure panels to pilasters with not less than 2 stirrup brackets located to align with stirrup brackets at wall. Secure panels in position with manufacturer's recommended anchoring devices.
- E. Secure pilasters to floor and level, plumb, and tighten installation with devices furnished. Secure overhead brace to each pilaster with not less than 2 fasteners.
- F. Hang doors and adjust so tops of doors are parallel with overhead brace with doors closed.
- G. Provide clearances of not more than 1/2" between pilasters and panels, not more than 1" between panels and walls, not more than a uniform 3/16" at vertical edges of doors and pilasters.

3.2 ADJUSTING AND CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.
- B. Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION 102113

SECTION 102116 - SHOWER AND DRESSING COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-plastic compartments.
 - 2. Shower receptors.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For shower and dressing compartments.
 - 1. Include plans, elevations, sections, centerline of drains, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

1.3 COORDINATION

- A. Units are larger than existing door frames. Coordinate with demolition activities to remove and replace door frame(s) & walls as needed to deliver units into shower rooms and second floor.
- B. Coordinate to have shower units delivered prior to constructing new interior walls in building.
- C. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with shower and dressing compartments by field measurements before fabrication & delivery.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in ICC A117.1 for shower and dressing compartments designated as accessible.

2.2 SOLID-PLASTIC COMPARTMENTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Aquatic Model 136364PC or equal, where indicated on Drawings or comparable product by one of the following:
 - 1. Aquarius Bathware.
 - 2. Florestone.
 - 3. Hamilton Bathware.
- B. Description:
 - 1. Four piece unit.
 - 2. 4 inch skirt height.

3. Center drain.
4. Slip resistant floor.

2.3 ACCESSORIES

- A. Curtain Rod with Hooks: Manufacturer's standard, 1-inch- diameter, stainless-steel curtain rod with matching hooks.
- B. Curtain: Flame-resistant, manufacturer's standard fabric that is stain resistant, self-sanitizing, antistatic, antimicrobial, and launderable to a temperature of not less than 90 deg F.
 1. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
 3. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than 1 inch and not less than 1/2 inch above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than 1/2 inch.
 4. Color and Pattern: As selected by DMVA from manufacturer's full range.
- C. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.
- B. Curtains: Install curtains to specified length, and verify that they hang vertically without stress points or diagonal folds.
- C. Shower Receptors: Install prefabricated shower receptors with drain gasket compression fit to OD of waste pipe.

3.2 ADJUSTING

- A. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease- and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.
- B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102116

SECTION 102233 - ACCORDION FOLDING PARTITIONS

1.1 SUMMARY

A. Section Includes:

1. Manually operated, accordion folding partitions.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.

1.2 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. STC: Sound Transmission Class.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For accordion folding partitions.

1. Include plans, elevations, sections, and attachment details.
2. Indicate storage and operating clearances.
3. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
4. Indicate facing-material seam locations if any.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of exposed material, facing material, and finish indicated.

1. Include similar Samples of accessories involving color selection.

D. Sample Warranty: For manufacturer's special warranty.

E. Operation and Maintenance Data: For accordion folding partitions to include in maintenance manuals.

1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of accordion folding partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Faulty operation of accordion folding partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period: Two years from date of Substantial Completion.
3. Warranty Period for Pantographic Frames, Trolleys, and Tracks: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Acoustical Performance: Provide accordion folding partitions tested by a qualified testing agency for the following acoustical properties, according to test methods indicated:
 - 1. Sound-Transmission Requirements: Accordion folding partition assembly tested in a laboratory for sound-transmission loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.
- B. Fire-Test-Response Characteristics: Provide partitions with finishes complying with one of the following, as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

2.2 ACCORDION FOLDING PARTITION

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Modernfold, Inc., Soundmaster #8 Accordion Folding Partition** or a comparable product.
- B. STC: 39.
- C. Facing Material: Reinforced heavy-duty vinyl with woven backing weighing not less than 30 ounces per linear yard.
 - 1. Color/Pattern: As selected by DMVA from manufacturer's full range.

2.3 COMPONENTS

- A. Posts and Seals: Provide types of posts and seals that produce accordion folding partitions complying with performance requirements.
 - 1. Posts: Steel or aluminum; formed with deep-nesting and interlocking interfaces and fabricated to ensure rigidity of accordion folding partition.
- B. Hardware: Manufacturer's standard manually operated pulls, latches, locks, and bolts as required to operate accordion folding partitions; with decorative, protective finish.
- C. Trim: Manufacturer's standard with decorative, protective finish.
- D. Tiebacks: As required to maintain accordion folding partitions in stacked position; with manufacturer's standard finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of accordion folding partitions.

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

3.2 INSTALLATION

- A. Comply with accordion folding partition manufacturer's written installation instructions. Install accordion folding partitions level and plumb, with tight joints and uniform appearance, and free of deformation and surface and finish irregularities.
- B. Install accordion folding partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Broken, cracked, chipped, deformed, or unmatched sections are unacceptable.
- D. Broken, cracked, deformed, or unmatched seals or seals with gaps at butted ends are unacceptable.
- E. Light-Leakage Test: Illuminate one side of partition installation, and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 ADJUSTING

- A. Adjust accordion folding partitions to operate smoothly, without warping or binding. Lubricate hardware and other moving parts as recommended by manufacturer.

END OF SECTION 102233

SECTION 102800 - TOILET AND BATH ACCESSORIES

PART ONE – DESCRIPTION

- A. Provide toilet and bath accessories indicated.
 - 1. Paper Towel Dispensers.
 - 2. Toilet Paper Dispensers.
 - 3. Mirrors.
 - 4. Robe Hooks.
 - 5. Custodial Accessories.
 - 6. Child Care Accessories.

1.1 SUBMITTALS

- A. Product Data for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.
- B. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.
- C. Setting drawings where cutouts are required in other work, including templates, substrate preparation instructions, and directions for preparing cutouts and installing anchorage devices.
- D. Maintenance instructions including replaceable parts and service recommendations.

1.2 QUALITY ASSURANCE

- A. Inserts and Anchorages - Install accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.
- B. Coordination - Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

PART TWO - PRODUCTS:

2.1 AVAILABLE MANUFACTURERS

- A. Basis-of-Design Products – Wherever a basis-of-design product is listed, the design is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. A & J Washroom Accessories
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equip., Inc.
 - 4. Bradley Corporation.
 - 5. General Accessory Mfg Co.
 - 6. McKinney/Parker

2.2 MATERIALS, GENERAL

- A. Stainless Steel - ASTM A 666, Type 304, with No. 4 (satin) finish, in 0.0312" minimum thickness, unless otherwise indicated.
- B. Brass - ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
- C. Sheet Steel - ASTM A 366 A, cold-rolled, commercial quality, 0.0359" minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet - ASTM A 653/A, G60.
- E. Chromium Plating - ASTM B 456, Service Condition SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- F. Baked Enamel Finish - Factory-applied, gloss white, baked acrylic enamel coating.
- G. Mirror Glass - ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
- H. Galvanized Steel Mounting Devices - ASTM A 153, hot-dip galvanized after fabrication.
- I. Fasteners - Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION, GENERAL

- A. Product Identification - One, maximum 1-1/2" diameter, unobtrusive stamped manufacturer logo is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories - Fabricate with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- C. Framed Mirrors - Fabricate frames for glass-mirrors to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
 - 1. Provide galvanized steel backing sheet, not less than 0.034" and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
 - 2. Mirror Hangers - Provide mirror mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
 - a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror in position with no exposed screws or bolts.
 - b. At Contractor's option, heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

- D Keys - Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner.
- 2.4 PAPER TOWEL DISPENSERS
- A. **(PTD)** - Surface-Mounted Towel Dispensers - Fabricate of stainless steel with hinged front equipped with tumbler lockset. Provide pierced slots at sides as refill indicator; equal to **Bobrick B-262**.
- B. Capacity - Not less than 400 C-fold or 525 multi-fold paper towels.
- 2.5 TOILET PAPER DISPENSERS
- A. **(TPD)** - Single-Roll Dispenser – Standard core roll; equal to **MOEN BP1808CH**.
- B. Mounting - Surface mounted, concealed anchorage, and stainless steel collar.
- 2.6 MIRRORS, WALL
- A. **(WM1)** equal to **Bobrick B-166 1830**, 18” x 30”, mirror, with shelf, one continuous unit, see Drawings for locations.
- B. **(WM2)** equal to **Bobrick B-290**, 18” x 36”, mirror, no shelf, one continuous unit, see Drawings for locations.
- 2.7 ROBE HOOKS
- A. **(RH)** - Robe Hooks equal to **Bobrick B-2116**; heavy-duty satin-finished stainless steel robe hook; for concealed mounting.
- 2.8 CUSTODIAL ACCESSORIES
- Provide and install (1) each at all new janitor sinks.
- A. Utility Shelf with mop/broom holders and rag hooks – **Brobrick B-239**.
- B. Single Hose Bracket – Ferguson’s **Proflo** Model PF296.
- C. Service Sink Hose – Ferguson’s **Proflo** PFSSHE, 5/8” x 30”.
- D. Stainless Steel Wall Shelf – **Regency** Model 600WS1224HD.
- E. Stainless Steel Wall Guard - Ferguson’s **Proflo** Model PFWG24S, 12” High.
- 2.9 CHILDCARE ACCESSORIES
- A. Diaper-Changing Station
1. Equal to Koala Kare KB200 Baby Changing Station or an approved equal.
 2. Mounting: Surface mounted.
 3. Operation: By pneumatic shock-absorbing mechanism.

PART THREE - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate and recommended by accessory manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.
- C. Secure Railing to masonry wall with concealed, tamper-resistant special hangers, toggle bolts, or screws. Railing shall comply with barrier-free accessibility guidelines (including ADAAG in the U.S.A.) for structural strength.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 122113 - HORIZONTAL LOUVER BLINDS

PART ONE GENERAL

1.01 SUMMARY

- A. Provide blinds with aluminum louver 1” wide slats for all new window openings.

1.02 SUBMITTALS

- A. Product Data – For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating.

PART TWO PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers include, but are not limited to, the following:
 - 1. Comfortex Window Fashions.
 - 2. Hunter Douglas window Fashions.
 - 3. Levolor Contract; a Newell Company; Levolor.
 - 4. Springs Window Fashions Division, Inc.
 - 5. Verosol USA, Inc.

2.02 HORIZONTAL LOUVER BLINDS, ALUMINUM LOUVER SLATS

- A. Louver Slats – Aluminum, alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
 - 1. Nominal Slat Width – 1 inch.
 - 2. Thickness – not less than .008 inches.
 - 3. Spacing – Manufacturer’s standard.
 - 4. Color – DMVA to choose from manufacturer’s full range.
 - 5. Ionized Coating – Antistatic, dust-repellent, baked polyester finish.
- B. Headrail – Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one blind per headrail.
 - 1. Finish Color Characteristics – Match color, texture, pattern and gloss of louver slats.
- C. Bottom Rail – Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends, bottom contoured for minimizing light gaps; with enclosed and protected ladders and tapes to prevent their contact with sill.
- D. Maximum Light Blocking Blinds – Designed for eliminating all visible light gaps if slats are tilted closed; with tight tape spacing indicated and slats with minimal-sized rout holes for ladders hidden and placed near back edge for maximum slat overlap; with headrail and bottom rail extended and formed for light-tight joints between rail and adjacent slats or construction.
- E. Tilt Control – Consisting of enclosed worm gear mechanism, slip clutch or detachable wand preventing overrotation, and linkage rod, for the following operation.
 - 1. Tilt Operation – Manual with clear plastic wand or cord-operated tilter.
 - 2. Length of Tilt Control – Full length of blind.
 - 3. Tilt – Full.

- F. Lift Operation – Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.
- G. Tilt-control and Cord-Lock Position – Right side and left side of headrail, respectively.
- H. Ladders – Evenly spaced to prevent long-term louver sag.
- I. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
 - 1. Type: Wall.
 - 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
- J. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
- K. Mounting - Permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment.
 - 1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

2.03 HORIZONTAL LOUVER BLINDS FABRICATION

- A. Product Standard and Description – Comply with AWCMA document 1029, unless otherwise indicated, for each horizontal louver blind designed to be self-leveling and consisting of louver slats, rails, ladders, tapes, lifting and tilting mechanisms, cord, cord lock, tilt control, and installation hardware.
- B. Concealed Components – Noncorrodible or corrosion-resistant-coated materials.
 - 1. Lifting and Tilting Mechanisms – With permanently lubricated moving parts.
- C. Unit Sizes – Obtain units fabricated in sizes to fill window openings.
 - 1. Blind Units Installed between Jambs – Width equal to $\frac{1}{4}$ " per side or $\frac{1}{2}$ " total, plus or minus $\frac{1}{8}$ ", less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to $\frac{1}{4}$ ", plus or minus $\frac{1}{8}$ ", less than head-to-sill dimension of opening in which each blind is installed.
- D. Installation Brackets – Designed for easy removal and reinstallation of blind, for supporting headrail and operating hardware, and for hardware position and blind mounting method indicated.
- E. Installation Fasteners – Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- F. Color-Coated Finish, Metal – For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- G. Component Color – Provide rails, cords, ladders, and exposed-to-view metal and plastic matching or coordinating with slat color.

PART THREE - EXECUTION**3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Install blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions and located so exterior louver edges in any position are not closer than 2" to interior face of glass, but not protruding into room interior. Install intermediate support as required to prevent deflection in head rail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware, if any.

3.03 ADJUSTING

- A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.04 CLEANING AND PROTECTION

- A. Clean blind surfaces after installation, according to manufacturer's written instructions.
- B. Replace damaged blinds that cannot be repaired, in a manner approved by DMVA, before time of Substantial Completion.

END OF SECTION 122113

SECTION 122116 - VERTICAL LOUVER BLINDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vertical louver blinds with **PVC** vanes.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For vertical louver blinds, include fabrication and installation details.

C. Samples: For each exposed product and for each color and texture specified.

D. Product Test Reports: For vertical louver blinds with polymer vanes that have been tested for compliance with NFPA 701 for tests performed by [**manufacturer and witnessed by a qualified testing agency**] [**a qualified testing agency**].

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver vertical louver blinds in factory packages, marked with manufacturer and product name, and location of installation using same designations indicated on Drawings.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not install vertical louver blinds until construction and wet-work and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where vertical louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain vertical louver blinds from single source from single manufacturer.

2.2 VERTICAL LOUVER BLINDS, PVC VANES

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Hunter Douglas Architectural, Contract Vertical Bling** or an DMVA approved equal.

- B. Vanes: Lead-free, UV-stabilized, integrally colored, opaque, permanently flexible, extruded PVC that will not crack or yellow; with not less than 3/8-inch overlap when vanes are rotated fully closed.
1. Width: 3-1/2 inches.
 2. Profile: Curved.
 3. Flame-Resistance Rating: Comply with NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 4. Features:
 - a. Bottom chain.
 - b. <Insert feature>.
- C. Headrail: Channel, formed steel or extruded aluminum with long edges returned or rolled and ends capped. Headrail encloses operating mechanisms including carrier-spacing mechanism that provides uniform vane spacing when blinds are traversed fully across headrail (closed).
1. Manual Traverse Control: Nickel-plated, metal bead chain.
 2. Manual Rotation Control: Nickel-plated, metal bead chain.
 3. Manual Control Locations: As indicated on Drawings.
 4. Draw and Stack: As indicated on Drawings.
- D. Carriers: Engineered plastic with gears to align and synchronize vane rotation and stems that allow vane removal and replacement. Lead carriers have self-lubricating wheels or elongated bearing surfaces; remaining carriers have self-lubricating wheels.
- E. Valance: Manufacturer's standard with vane insert.
- F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
1. Type: As indicated.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
- G. Colors, Textures, and Patterns:
1. Vanes: As selected by DMVA from manufacturer's full range.
 2. Components: Provide materials exposed to view matching or coordinating with vanes unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install vertical louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior vane edges are not closer than 2 inches from interior faces of glass and not closer than 1-1/2 inches from interior faces of glazing frames through full operating ranges of blinds.
2. Install mounting and intermediate brackets to prevent deflection of headrails.
3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

- A. Adjust vertical louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

- A. Clean vertical louver blind surfaces after installation according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that vertical louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged vertical louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

END OF SECTION 122116

SECTION 122413 - ROLLER SHADES

PART ONE - GENERAL

1.01 SUMMARY

- A. Section includes manually operated roller shades.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Samples: For each exposed product and for each color and texture specified.

PART TWO - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Hunter Douglas SheerWeave 4800 Mesh Roller Shades** or comparable product by one of the following:
 - 1. Draper Inc.
 - 2. OEM Shades Inc.
 - 3. Shade Techniques, LLC.

2.02 ROLLER SHADES

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Manufacturer's standard.
 - 2. Loop Length: Full length of roller shade.
 - 3. Limit Stops: Provide upper and lower ball stops.
 - 4. Chain-Retainer Type: Chain tensioner, jamb mounted.
- B. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
 - 1. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:

1. Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
2. 1% Openness Factor.
3. Mesh Weave
4. Weight 18.5 Oz./square Yard
5. 76% PVC on Polyester, 24% polyester
6. Shadeband Bottom (Hem) Bar: 2" Sealed Pocket Hem bar
7. Color: As selected by DMVA Project Manager from manufacturer's full range.

F. Installation Accessories:

1. Front Fascia: Manufacturer's standard that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
2. Endcap Covers: To cover exposed endcaps.

2.03 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch . Length equal to head-to-sill dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

PART THREE - EXECUTION**3.01 ROLLER-SHADE INSTALLATION**

- A. Install roller shades level, plumb, and aligned with adjacent units, according to manufacturer's written instructions.
- B. Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- D. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 122413

SECTION 123530 - RESIDENTIAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes kitchen cabinets.

1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Cabinets.
 - 2. Cabinet hardware.
- B. Shop Drawings: Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, and hardware.
- C. Samples: For cabinet finishes and countertop.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

PART 2 - PRODUCTS

2.1 CABINETS

- A. Basis of Design Product: Subject to compliance with requirements, provide **Merillat Classic Spring Valley oak** cabinets or an approved equal.
 - 1. Quality Standard: Provide cabinets that comply with KCMA A161.1.
 - 2. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semiexposed location of each unit and showing compliance with the above standard.
 - 3. Face Style: Traditional overlay.
 - 4. Cabinet Style: Face frame.
 - 5. Door and Drawer Fronts: Solid-wood stiles and rails, ¾ inch thick, with ¼ -inch thick, veneer-faced plywood center panels.
 - 6. Face Frames: ¾ x 1 ½ inch thick solid hardwood rail and stile members. Center stiles shall be ¾ inch thick x 3 inch solid hardwood.
 - 7. Shelving - Not less 5/8" thick particleboard core plywood or 1/2" thick medium density particleboard prefinished with minimum 4 mil vinyl laminate on top, bottom and exposed (front) edge.
- B. Wall Cabinet Construction

1. Tops and Bottoms - Not less than 1/2" thick particleboard or 3/8" thick hardwood plywood, fully supported by, and secured in, rabbets in end panels, front frame and back rail.
2. Backs - Not less than 1/8" hardboard or 3/16" plywood fastened to machined rear edge of ends and to top and bottom hanger rails.

C. Base Cabinet Construction

1. Front Frame Drawer Rails - Not less than 1" x 1 1/4" lumber mortised and fastened into face frame.
2. Bottoms - Not less than 1/2" thick particleboard with 4 mil vinyl laminate finish or 3/8" thick, 5 ply veneer core plywood secured in and fully supported rabbets in end panels, front frame and back bottom rail.
3. Back Panels - Not less than 1/8" thick hardboard fastened to machined rear edge of end panels and to top and bottom rails. Interior surface prefinished with 4 mil vinyl laminate.
4. Toe Boards - Not less than 5/8" particleboard core attached between end panels and extended from bottom panel to floor.
5. Corner Blocks - Glued and fastened in each of 4 top corners to maintain cabinet squareness and rigidity.

D. Drawer Construction

1. Drawer Body - Not less than 3/8" thick vinyl faced particleboard subfront, back and sides. Provide box type construction with subfront and back rabbeted into sides and secured with glue and mechanical fasteners. Exposed fronts fastened to subfront with mounting screws from interior of body. Drawer bottom of not less than 1/4" thick hardboard, set into rabbets in back, sides and front.
2. Drawer Suspension - Minimum 50 lb. capacity twin track, side-mounted drawer glide suspension with nylon rollers, self-closing feature and positive stop.

2.2 CABINET HARDWARE

- A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range.
- B. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or Type B05091.

2.3 COUNTERTOPS

- A. Basis-of-Design was **CurvFlo's FLEETWOOD** (solid wood edge) Kitchen/vanity Top; See Drawing Sheet A-300.
 1. Countertop Standard - ANSI A161.2.
 2. Exposed Surfacing Material – Grade 10 General Purpose Grade HGS, nominal thickness .048", ANSI A161.2.
 3. Substrate (Core) for Exposed Surfacing Material – 3/4" industrial grade particleboard.
 4. Countertop Configuration – Kitchen/Vanity; 5/16" red oak ogee front and top edges.
 5. Oak edge to be stained to match cabinets and sealed.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.
- B. Install cabinets without distortion so doors and drawers fit the openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.
- C. Install cabinets level and plumb to a tolerance of 1/8 inch in 8 feet.
- D. Fasten cabinets to adjacent units and to backing.
 - 1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through the metal backing or metal framing behind the wall finish.
- E. Complete hardware installation and adjust doors and drawers for proper operation.
- F. Caulk top edge and vertical ends of backsplash to wall full length.

3.2 ADJUSTING AND CLEANING

- A. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

END OF SECTION 123530

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes mechanical materials and work common to other HVAC sections as follows:
1. Sleeves and Sleeve Seals.
 2. Grout.
 3. Escutcheons and Floor Plates.
 4. Pressure Gages and Test Plugs.
 5. Hangers and Support for Plumbing piping.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVE AND SLEEVE SEALS

- A. Galvanized-Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. PVC Pipe: ASTM D 1785, Schedule 40.
- C. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.2 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2.3 ESCUTCHEONS AND FLOOR PLATES

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- C. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.4 PRESSURE AND TEST PLUGS

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Standard: ASME B40.100.
 - 2. Case: Sealed Open-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 - 3. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 4. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi .
 - 5. Pointer: Dark-colored metal.
 - 6. Window: Plastic.
 - 7. Ring: Metal.
 - 8. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
- B. Test Plug: Corrosion-resistant brass or stainless-steel body with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating of 500 psig at 200 deg F.

2.5 HANGARS AND SUPPORTS FOR PLUMBING

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Fastener Systems:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- C. Miscellaneous Materials:
 - 1. Structural Steel: ASTM A 36, carbon-steel plates, shapes, and bars; black and galvanized.
 - 2. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - a. Properties: Nonstaining, noncorrosive, and nongaseous.
 - b. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
 - D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
 - E. Install piping to permit valve servicing.
 - F. Install piping at indicated slopes.
 - G. Install piping free of sags and bends.
 - H. Install fittings for changes in direction and branch connections.
 - I. Install piping to allow application of insulation.
 - J. Select system components with pressure rating equal to or greater than system operating pressure.
 - K. Sleeves:
 - 1. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
 - 2. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
 - L. Escutcheons & Floor Plates:
 - 1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
 - 2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 3. Install floor plates for piping penetrations of equipment-room floors.
 - 4. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - M. Install unions at final connection to each piece of equipment.
 - N. Install dielectric unions and flanges to connect piping materials of dissimilar metals in gas piping.
 - O. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.
- 3.2 HANGARS AND SUPPORTS
- A. Comply with MSS SP-69 and MSS SP-89. Install building attachments within concrete or to structural steel.
 - B. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.
 - C. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

- D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
- E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

3.3 GENERAL EQUIPMENT INSTALLATIONS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Mix and install grout for pump and other equipment base plates, and anchors. Place grout, completely filling equipment bases.

END OF SECTION 220500

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Valve tags.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Labels for Equipment:
 - 1. Material and Thickness: Brass, stainless steel, aluminum, or anodized aluminum, or multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled or stamped holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 - 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.3 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch or stainless steel, 0.025-inch or aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain.
- B. Valve Tag Contents: Include identification of valve using same designations or abbreviations as used on Drawings; also include zone identification, valve model number, size, and rate flow in GPM.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:
1. Equipment Drains:
 - a. Background: Brown.
 - b. Letter Colors: White.
 2. Domestic Water Piping (Cold):
 - a. Background: Safety green.
 - b. Letter Colors: White.
 3. Domestic Water Piping (Hot Water Supply):
 - a. Background: Orange.
 - b. Letter Colors: White.
 4. Domestic Water Piping (Hot Water Return):
 - a. Background: Safety Green.
 - b. Letter Colors: White.
 5. Sanitary Waste Piping:
 - a. Background Color: Brown.
 - b. Letter Color: White.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 1. Domestic cold-water piping.
 2. Domestic hot-water piping.
 3. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 SUBMITTALS

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

1.3 COORDINATION

- A. Coordinate clearance requirements with piping Installer for piping insulation application.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Mineral-Fiber, Preformed Pipe Insulation:
 1. Basis of Design: Subject to compliance with requirements, provide **Knauf Earthwool 1000** or a comparable product by one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 2. Description:
 - a. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
 - b. ASJ-SSL - White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I and self-sealing lap with pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 4. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 4. Color: White or gray.
 - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color: White.
 - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.

2.7 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
 - 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel, or 0.062-inch soft-annealed, galvanized steel.

2.8 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
 - 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.2 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.3 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and

replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.5 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.6 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Flexible connectors.
 2. Vibration-control devices.
 3. Underground piping.
 4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
 5. Air chambers, unions, strainers, check valves, and flow regulators.

3.7 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
1. Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I with white jacket: 1 inch thick.
- B. Domestic Hot Water:
1. Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I with white jacket: 1 inch thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING**PART 1 - GENERAL**

1.1 SUMMARY

- A. This section includes domestic water piping inside the building as indicated.

1.2 SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.
- B. System purging and disinfecting activities report.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.

- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping

2.4 VALVES

- A. Valves, General:
 - 1. Refer to Part 3 "Valve Applications" Article and Drawings for applications of valves.
 - 2. Valve Pressure and Temperature Ratings - Not less than indicated and as required for system pressures and temperatures.
 - 3. Sizes - Same size as upstream pipe, unless otherwise indicated.
 - 4. Extended Valve Stems - Where insulation is indicated.
- B. Ball Valves - Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim.
 - 1. Standard: MSS SP-110.
 - 2. SWP Rating: 150 psig.
 - 3. CWP Rating: 600 psig.
 - 4. Body Design: Two piece.
 - 5. Body Material: Bronze.
 - 6. Ends: Threaded.
 - 7. Seats: PTFE or TFE.
 - 8. Stem: Bronze.
 - 9. Ball: Chrome-plated brass.
 - 10. Port: Full.
- C. Bronze Gate Valves.
 - 1. Class 125, NRS Bronze Gate Valves:
 - 2. Standard: MSS SP-80, Type 1.
 - 3. CWP Rating: 200 psig.
 - 4. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - 5. Ends: Threaded.
 - 6. Stem: Bronze.
 - 7. Disc: Solid wedge; bronze.
 - 8. Packing: Asbestos free.
 - 9. Handwheel: Malleable iron.
- D. Drain Valves.
 - 1. Ball-Valve-Type, Hose-End Drain Valves:
 - 2. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 - 3. Pressure Rating: 400-psig minimum CWP.
 - 4. Size: NPS 3/4.
 - 5. Body: Copper alloy.
 - 6. Ball: Chrome-plated brass.
 - 7. Seats and Seals: Replaceable.
 - 8. Handle: Vinyl-covered steel.
 - 9. Inlet: Threaded or solder joint.
 - 10. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valves types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 and smaller.
 - 2. Drain Duty: Hose-end drain valves.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors.

- P. Install sleeve seals for piping penetrations of concrete walls and slabs.
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. Install sectional valve close to main on each branch and riser serving 2 or more plumbing fixtures or equipment. Use gate or ball valves for piping NPS 2 and smaller.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use gate or ball valves for piping NPS 2 and smaller.
- C. Install drain valves for equipment, at base of each riser, at low points of horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- B. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

- C. Install supports for vertical copper tubing every 10 feet.
- D. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
- E. Install supports for vertical steel piping every 15 feet.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

- 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
1. Hard or soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; copper, solder-joint fittings; and brazed joints.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Backflow preventers.
 2. Temperature-actuated, water mixing valves.
 3. Strainers.
 4. Water-hammer arresters.
 5. Wall hydrants.
 6. Drain valves.
 7. Trap-seal primer valves.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G.

2.2 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers – **Equal to Watts 009-UM1:**
1. Standard: ASSE 1013.
 2. Operation: Continuous-pressure applications.
 3. Pressure Loss: 12 psig maximum, through middle third of flow range.
 4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 5. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 6. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection

2.3 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Powers; a division of Watts Water Technologies, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 2. Standard: ASSE 1069, 1070, thermostatically controlled, water tempering valve.

3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Brass body with corrosion-resistant interior components.
5. Temperature Control: Adjustable between 80-120 degrees F.
6. Capacity: 12 gpm at 45psi
7. Minimum flow rated at .5 gpm.
8. Inlets and Outlet: Threaded.
9. Lockable tamper resistant handle.
10. Integral check valves and inlet screens.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.047 inch.
6. Drain: Pipe plug.

2.5 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Zurn Shoktrol Series**, ASSE 1010, or PDI-WH 201, piston type with pressurized cushioning chamber. sizes are based on water-supply fixture units, ASME A112.26.2M sizes A through F and PDI-WH 201 sizes A through F or comparable product by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. Precision Plumbing Products, Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Watts Drainage Products.
 - f. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2.6 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Basis-of-Design Product – Subject to compliance with requirements, provide, **Woodford 65** Freezeless Wall Hydrant or an approved equal.
2. Description – Brass valve body with hemispherical seating surface-One piece valve plumger-Copper casing tubes.
 - a. Finish – Brass.
 - b. Loose key.
 - c. 3/8” solid brass operating rod.
 - d. Max pressure: 125 p.s.i.
 - e. Max Temp.: 120 F.
 - f. ASSE Standard 1019-B approved.

2.7 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device – **Basis-of-design is WATTS Series A200:**
1. Standard: ASSE 1018.
 2. Pressure Rating: 125 psig minimum.
 3. Body: Bronze.
 4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- D. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve, and pump.
- E. Install water-hammer arresters in water piping according to PDI-WH 201.

- F. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 ADJUSTING

- A. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
- D. Solvent Cement: ASTM D 2564.

2.3 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:

- a. Standard: ASTM C 1173.
- b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- c. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and

reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- K. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- L. Install aboveground PVC piping according to ASTM D 2665.
- M. Install underground PVC piping according to ASTM D 2321.
- N. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- B. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

- C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Unshielded, nonpressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220500 "Common Work Results for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install supports for vertical cast-iron soil piping every 15 feet.
- F. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
- G. Install supports for vertical ABS and PVC piping every 48 inches.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.10 PIPING SCHEDULE

- A. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- B. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Cleanouts.
 2. Floor drains.
 3. Roof flashing assemblies.
 4. Miscellaneous sanitary drainage piping specialties.
 5. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Cast-Iron Floor Cleanouts (CO):
1. ASME A112.36.2M, cast-iron body with straight threads and gasket seal or taper threads for plug, flashing flange and clamping ring, and a brass closure plug. Cleanouts for installation in floors not having membrane waterproofing may be furnished without clamping ring. Size as indicated on drawings, or where not indicated, same size as connected drainage piping; equal to **Zurn ZN-1402** Round Nickel Brass Top and **Zurn ZN-1402-HD** with areas subject to heavy traffic.
- B. Cast-Iron Wall Cleanouts (CO):
1. Standard: ASME A112.36.2M. Include wall access equal to **Model ZS-1469**.
 2. Size: Same as connected drainage piping.
 3. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
 4. Closure: Countersunk brass plug.
 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 6. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains (FD):
1. ASME A112.6.3, cast-iron body, with seepage flange and clamping device. Floor drains for installation in floors not having membrane waterproofing may have seepage flange without clamping device. Size outlet as indicated; equal to **Zurn Z-415-BZ**.

- B. Seal Traps equal to **Zurn Z1000, with Sureseal Inline Trap Sealers.**

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- F. Install floor-drain, inline trap-seals on all floor drains that require trap-seal protection.
1. Size: Same as floor drain inlet.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- H. Install vent caps on each vent pipe passing through roof.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221329 - SANITARY SEWERAGE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submersible effluent pumps.
 - 2. Sewage-pump basins and basin covers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE EFFLUENT PUMPS

- A. Submersible, Quick-Disconnect, Double-Seal, Effluent Pumps:
 - 1. Basis of Design – **Gould Pumps Model HSUL 3x3-10 submersible pump**. Subject to compliance with requirements, manufacturers offering air handling units which may be incorporated in the work include, but are not limited to, the following:
 - a. ABS; Cardo Flow Solutions.
 - b. Bell & Gossett; a Xylem brand.
 - c. Flygt; a brand of Xylem Inc.
 - d. Gorman-Rupp Company (The).
 - 2. Description: Factory-assembled and -tested effluent-pump unit with guide-rail supports.
 - 3. Pump type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal effluent pump as defined in HI 1.1-1.2 and HI 1.3.

4. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
5. Impeller: Statically and dynamically balanced, ASTM A 48, Class No. 35B cast iron and stainless steel, with stainless-steel cutter, grinder, or slicer assembly; nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
7. Seals: Mechanical.
8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: Air.
10. Controls:
 - a. Disconnect Switch:
 - 1) Enclosure: Stainless Steel, NEMA 250, Type 4X.
 - 2) Fusible Switches – Fused, each phase; general duty; horsepower rated; non-feasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro-silver plated current carrying parts; hinged doors; operating lever arranged for locking in the “OPEN” position; arc quenchers; capacity and characteristics shall be adequate for the equipment.
 - b. Lift Station Controls Enclosure: Stainless steel, NEMA 250, Type 4X with hinged inner door, pedestal-mounted with stainless steel unistrut and concrete foundation. Including the following:
 - 1) Seal fail circuitry and detection relays.
 - 2) High level alarm beacon with reset push button.
 - 3) High level alarm horn with silence push button.
 - 4) Press to test pilot lights.
 - 5) HOA selector switch for each pump.
 - 6) 6-digit elapsed time meters for each pump.
 - 7) Condensation heater with thermostat.
 - 8) GFCI outlet, weather proof.
 - c. Switch Type: Mercury-float type, in NEMA 250, Type 6 enclosures with mounting rod, electric cables, and terminal boxes.
 - d. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - e. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
11. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.
12. Guide-Rail Supports:
 - a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
 - c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.

- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
 - e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
 - f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
 - g. Lifting Cable/Chain: Stainless steel; attached to pump and cover at manhole.
- B. Capacities and Characteristics:
- 1. Number of Pumps: Two.
 - 2. Each Pump:
 - a. Capacity: 2,800 gpm.
 - b. Solids Handling Capability: 2 inches minimum.
 - c. Total Dynamic Head: 140 feet.
 - d. Discharge Pipe Size: 4 NPS.
 - e. Electrical Characteristics:
 - 1) Volts: 208.
 - 2) Phases: Three.
 - 3) Hertz: 60.

2.2 BASIN COVERS

- A. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, valves, vent connections, and power cables.
- 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.3 DISCHARGE PIPING

- A. Provide all required piping and valves from pump discharge to outlet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.2 INSTALLATION

- 1. Install all equipment per manufacturer's recommendations.
- B. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Pumps and controls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221329

SECTION 224200 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Faucets for lavatories and lactation room sink.
 2. Faucets for showers
 3. Flushometers.
 4. Toilet seats.
 5. Fixture supports.
 6. Water closets.
 7. Urinals.
 8. Lavatories.
 9. Lactation room sink.
 10. Fittings, trim, and accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Operation and Maintenance Data: Manufacturer's recommendations accompanying each fixture and fittings.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Basis-of-Design Product – Subject to compliance with requirements, provide **Chicago Faucet Company's 797-V1000CP** or a comparable product by one of the following:
1. American Standard Companies, Inc.
 2. Bradley Corporation.
 3. Chicago Faucets.
 4. Delta Faucet company.
 5. Eljer.
 6. Elkay Manufacturing Co.
 7. Grohe America, Inc.
 8. Kohler Co.
 9. Moen, Inc.
 10. Royal Brass Mfg. Co.
 11. Speakman Company.
 12. T & S Brass and Bronze Works, Inc.
 13. Zurn Plumbing Products Group; Commercial Brass Operation.
- B. Description – Two-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
1. Body Material – Commercial, solid brass.
 2. Finish - Polished chrome plate.
 3. Maximum Flow Rate – 0.5 gpm, unless otherwise indicated.

4. Centers - 4".
5. Mounting - Deck.
6. Handles – Lever.
7. Inlets - NPS 1/2.
8. Spout - Rigid.
9. Spout Outlet – Constant flow Aerator.
10. Operation – Cartridge.
11. Drain - Pop up.
12. Tempering Device - Not required.

2.2 LACTATION ROOM FAUCET

- A. Basis-of-Design Product – Subject to compliance with requirements, provide **Delta Chamberlain Collection, 25747LF** or a comparable product by one of the following:
1. American Standard Companies, Inc.
 2. Bradley Corporation.
 3. Broadway collection.
 4. Chicago Faucets.
 5. Delta Faucet company.
- B. Description – Two-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
1. Body Material – Commercial, solid brass.
 2. Finish - Polished chrome plate.
 3. Maximum Flow Rate – 1.2 gpm, unless otherwise indicated.
 4. Centers - 4".
 5. Mounting - Deck.
 6. Handles – Lever.
 7. Inlets - NPS 1/2.
 8. Spout - Rigid.
 9. Spout Outlet – Constant flow Aerator.
 10. Operation – Cartridge.
 11. Drain - Pop up.

2.3 SHOWER FAUCETS

- A. Basis-of-Design Product – Subject to compliance with requirements, provide, **Delta T13220** 13 series pressure balanced single handle mixing valve or a comparable product by one of the following:
1. Hansgrohe Inc.
 2. Leonard Valve Company.
 3. Powers; a Watts Industries Co.
 4. Symmons Industries, Inc.
 5. T & S Brass and Bronze Works, Inc.
- B. Description – Single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
1. Finish – Stainless steel.
 2. Maximum Flow Rate – 1.5 gpm.
 3. Supply Connections - NPS 1/2.

4. Shower Head Type – Swivel chrome plated brass.
5. Integral Volume Control – Required.
6. Temperature Indicator – Integral with faucet.

2.4 FLUSHOMETERS

A. Flushometer – Water Closet

1. Basis-of-Design Product – Subject to compliance with requirements, provide **Sloan Royal Model 111** Flushometer or a comparable product by one of the following:
 - a. Coyne & Delany Co.
 - b. Delta Faucet Company.
 - c. Sloan Valve Company.
 - d. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description – Flushometer for water closet fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design - Diaphragm operation.
 - b. Style - Exposed.
 - c. Inlet Size – NPS 1.
 - d. Trip Mechanism - Oscillating, lever-handle.
 - e. Consumption - 1.6 gal/flush.
 - f. Tailpiece Size - NPS 1-1/2 and standard length to top of bowl.

B. Flushometer – Urinal

1. Basis-of-Design Product – Subject to compliance with requirements, provide **Sloan Royal 186-1.0** Low Consumption or a comparable product by one of the following:
 - a. Coyne & Delany Co.
 - b. Delta Faucet Company.
 - c. Sloan Valve Company.
 - d. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description – Flushometer for urinal fixtures. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design - Diaphragm operation.
 - b. Style - Exposed.
 - c. Inlet Size – NPS $\frac{3}{4}$.
 - d. Trip Mechanism - Oscillating, lever-handle.
 - e. Consumption - 1.0 gal/flush.
 - f. Tailpiece Size - NPS $\frac{3}{4}$ and standard length to top of bowl.

2.5 TOILET SEATS

A. Basis-of-Design Product – Subject to compliance with requirements, provide **Olsonite 95SS** Extra Heavy Duty or a comparable product by one of the following:

1. Bemis Manufacturing Company
2. Church Seats
3. Kohler co.
4. Olsonite Corp.

B. Description – Toilet seat for water closet fixture.

1. Material – Molded, solid plastic.
2. Configuration - Open, without cover.
3. Size - Elongated.
4. Hinge Type - SSCT, self-sustaining, check.
5. Class - Heavy duty commercial.
6. Color - White.

2.6 FIXTURE SUPPORTS

- A. Urinal Support, **Zurn-1222** Plate Type System with Bearing Plate or fixture manufacturer's standard for indicated installation.
- B. Lavatory Support, **Zurn Z-1231** Concealed Arm System or fixture manufacturer's standard for indicated installation.

2.7 WATER CLOSETS

- A. Water Closets
 1. Basis-of-Design Product – Subject to compliance with requirements, provide **Kohler Co – K-4350 Wellcomme** or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - d. Eljer.
 - e. Kohler Co.
 2. Description - Floor -mounting, bottom-outlet, vitreous-china fixtures designed for flushometer valve operation.
 - a. Style - Flushometer valve.
 - b. Bowl Type - Elongated with design.
 - c. Design Consumption - 1.6 gal/flush.
 - d. Color - White.
 - e. Flushometer – See paragraph 2.4 above.
 - f. Toilet Seat – See paragraph 2.5 above.

2.8 URINAL

- A. Basis-of-Design Product – Subject to compliance with requirements, provide – **American Standard Washbrook Flowise Universal Urinal** or a comparable product by one of the following:
 1. American Standard Companies, Inc.
 2. Crane Plumbing, L.L.C./Fiat Products.
 3. Eljer.
 4. Kohler Co.
- B. Description - Wall-mounting, Top-outlet, vitreous-china fixture designed for flushometer valve operation.
 1. Washout type with extended shields.
 2. Strainer or Trapway - Separate removable strainer.
 3. Design Consumption – 0.5 gal/flush.
 4. Color - White.
 5. Supply Spud Size - NPS 3/4.

6. Outlet Size - NPS 2.
7. Flushometer – See Paragraph 2.4 above.
8. Fixture Support – See Paragraph 2.6 above.

2.9 LAVATORIES

- A. Lavatories - Wall-hanging, vitreous-china fixture.
 1. Products - **Kohler Co K-2030 Greenwich**.
 - a. Type - With back.
 - b. Size - 20" x 18".
 - c. Faucet Hole Punching - Three, 4" centers.
 - d. Faucet Hole Location – Top.
 - e. Color - White.
 - f. Faucet – See Paragraph 2.1 above, with pop-up waste.
 - g. Supplies - NPS 3/8 chrome-plated copper with stops.
 - h. Drain Piping - NPS 1 1/4" chrome-plated cast-brass trap, tubular brass waste to wall; and wall escutcheon.
 - i. Fixture Support – See Paragraph 2.6 above.

2.10 LACTATION ROOM SINK

- A. Basis-of-Design Product – Subject to compliance with requirements, provide **Elkay Celebrity Model BCR15** or a comparable product by one of the following:
 1. Advance Tabco
 2. AERO Manufacturing, Inc.
 3. Amtekco Industries, Inc.
 4. Elkay Manufacturing Co.
 5. Just Manufacturing Company
 6. Marlo Manufacturing.
 7. Metal Masters Foodservice Equipment co., Inc.
- B. Description – One-compartment, counter-mounting, stainless-steel bar sink.
 1. Overall Dimensions – 15" x 15".
 2. Metal Thickness – 20 gauge.
 3. Compartment:
 - a. Dimensions – 12" x 10" x 6".
 - b. Drain – Elkay Standard Strainer Model LK35.
 - 1) Location – Centered in compartments.
 - c. Faucets – Sink
 - 1) Number Required – **One each sink**.
 - 2) Mounting - Deck.
 - d. Supplies – NPS 1/2 chrome-plated copper with stops or shutoff valves.
 - e. Drain Piping – NPS 1-1/2 chrome-plated, cast-brass P-trap: 0.045" thick tubular brass or copper pipe waste with escutcheon.
 - f. Include an air admittance valve with tubular adapter, similar to **Oatey Sure-Vent AAV**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine rough-in of water and sanitary drainage and vent piping systems to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated before plumbing fixture installation.
- B. Examine floors and walls for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION

- A. Install plumbing fixtures level and plumb according to roughing-in drawings.
- B. Install floor-mounted water closets on closet flange attachments to drainage piping.
- C. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- D. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- E. Install toilet seats on water closets.
- F. Install traps on fixture outlets.
- G. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- H. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- I. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

- D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.4 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pressure water coolers and related components.

1.2 SUBMITTALS

- A. Product Data: For each type of pressure water cooler.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.
- C. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories - Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements - Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- C. NSF Standard - Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture material that will be in contact with potable water.
- D. ARI Standard - Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. ASHRAE Standard – comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Pressure Water Coolers with Bottle Filling Station (**EWC/BF**): Wall mounted, standard, wheelchair accessible.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Elkay Manufacturing Co; LZS8WSSP** or a comparable product by one of the following:
 - a. Halsey Taylor.
 - b. Haws Corporation.
 - c. Larco Inc.
 - d. Tri Palm International, LLC.
 - 2. Cabinet: All stainless steel.

3. Bubbler: One, with adjustable stream regulator, located on cabinet deck.
4. Control: Push bar.
5. Bottle Filler: Electronic sensor for touchless activation with an automatic 20-second shut-off timer. LED light illuminating the water dispensing area. Including a display showing how many plastic bottles are save from waste.
6. Drain: Grid with NPS 1-1/4 tailpiece.
7. Supply: NPS 3/8 with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
9. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
10. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Capacities and Characteristics:
 - a. Cooled Water: 8 gph.
 - b. Bottle Filler: 1.1 gpm.
 - c. Ambient-Air Temperature: 90 deg F.
 - d. Inlet-Water Temperature: 80 deg F.
 - e. Cooled-Water Temperature: 50 deg F.
 - f. Electrical Characteristics:
 - 1) Volts: 120-V ac.
 - 2) Phase: Single.
 - 3) Hertz: 60.
 - 4) Full-Load Amperes: 4.2.
12. Support: ASME A112.6.1M, Type I water-cooler carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation.

- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings.
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler.
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

SECTION 230500 - COMMON WORK RESULTS FOR HVAC**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes mechanical materials and work common to other HVAC sections as follows:
 - 1. Sleeves and Sleeve Seals.
 - 2. Grout.
 - 3. Escutcheons and Floor Plates.
 - 4. Pressure Gages and Test Plugs.
 - 5. Hangers and Support for HVAC piping.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES AND SLEEVE SEALS

- A. Galvanized-Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. PVC Pipe: ASTM D 1785, Schedule 40.
- C. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.2 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2.3 ESCUTCHEONS AND FLOOR PLATES

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- C. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.4 PRESSURE GAGES AND TEST PLUGS

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Standard: ASME B40.100.
 - 2. Case: Sealed Open-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 - 3. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 4. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 - 5. Pointer: Dark-colored metal.
 - 6. Window: Plastic.
 - 7. Ring: Metal.
 - 8. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
- B. Test Plug: Corrosion-resistant brass or stainless-steel body with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating of 500 psig at 200 deg F.

2.5 HANGERS AND SUPPORTS FOR HVAC

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Fastener Systems:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- C. Miscellaneous Materials:
 - 1. Structural Steel: ASTM A 36, carbon-steel plates, shapes, and bars; black and galvanized.
 - 2. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - a. Properties: Nonstaining, noncorrosive, and nongaseous.
 - b. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
 - D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
 - E. Install piping to permit valve servicing.
 - F. Install piping at indicated slopes.
 - G. Install piping free of sags and bends.
 - H. Install fittings for changes in direction and branch connections.
 - I. Install piping to allow application of insulation.
 - J. Select system components with pressure rating equal to or greater than system operating pressure.
 - K. Sleeves:
 - 1. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
 - 2. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
 - L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 PENETRATION FIRESTOPPING.
 - M. Escutcheons & Floor Plates:
 - 1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
 - 2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 3. Install floor plates for piping penetrations of equipment-room floors.
 - 4. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - N. Install unions at final connection to each piece of equipment.
 - O. Install dielectric unions and flanges to connect piping materials of dissimilar metals in gas piping.
 - P. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.
- 3.2 HANGERS AND SUPPORTS
- A. Comply with MSS SP-69 and MSS SP-89. Install building attachments within concrete or to structural steel.

- B. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.
- C. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
- E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

3.3 GENERAL EQUIPMENT INSTALLATIONS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Mix and install grout for pump and other equipment base plates, and anchors. Place grout, completely filling equipment bases.

END OF SECTION 230500

SECTION 230513 - ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT**PART 1 - GENERAL**

1.1 SUMMARY

- A. Provide basic electrical components which are an integral part of packaged mechanical equipment, including, but not limited to, factory installed motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements; i.e. horsepower and electrical characteristics, for mechanical equipment are schedule on the Drawings.

1.2 SUBMITTALS

- A. No separate submittal is required; submit component data with submittals for the equipment for which it serves, as required by the individual equipment specification Sections.

1.3 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.
- B. Electrical Characteristics for Mechanical Equipment – Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

- A. Motor horsepower specified shall be the minimum acceptable. Motors and accessories shall comply in all respects with ANSI, NEC, and NEMA Standards.
- B. Unless otherwise required, motors shall be open drip-proof squirrel cage induction, “T” Frame NEMA Design B having Class B insulation suitable for continuous duty at 40 degrees C. ambient and 90 degrees C. temperature rise for service factor of 1.15. Oversized motors to comply with this requirement are not acceptable. Totally enclosed motors shall have a temperature rise of 80 degrees C. for a service factor of 1.0. Motors shall have ball bearings with oil caps and filler cups. Totally enclosed motors shall be fan cooled.
- C. Efficiency – Motors shall be “Energy Efficient” having minimum efficiency as schedule in accordance with IEEE Standard 112, Test Method B. If efficiency is not schedule, provide motors with higher efficiency than “average standard industry motors”, in accordance with IEEE standard 112, Test Method B.
- D. Motor terminal boxes shall be sized to accommodate the conduit, wire size and terminal lugs shown in the Electrical Contract Documents.

- E. Where parallel feeders are required, motor terminal boxes shall be equipped with copper bus bars (size and number as required) to facilitate mounting feeder cable lugs to motor terminals.
- F. Insulation Resistance – Not less than one-half megohm between stator conductors and frame, to be determined at the time of final inspection and testing.

2.2 STARTERS AND CONTROL PANELS FOR FACTORY ASSEMBLED PACKAGE UNITS

- A. Starters shall be combination, fused across-the-line magnetic type with integral 120-volt control transformers.
- B. Factory assembled duplex or triplex package units shall be compartmentalized (each compartment physically isolated). Each compartment (one per motor) shall contain fused disconnect switch, 120 volt secondary control circuit transformer, starter with overload protection in each phase, auxiliary contacts, running lights, “Hand-Off-Auto” switch, numbered terminal block and all necessary control components. Starters shall be fed with individual power feeders, and each motor shall be capable of running even when the other motor starter disconnect is off. All control circuits extending to remote devices such as thermostats, flow switches, pressure switches, float switches, alternators, etc., shall be 120 volts. Where specified or shown, provide audible alarm device with silencer and dry relay contact for remote alarm indication.
- C. Motor starters, drives, and driven equipment which are electrical or mechanically interconnected within the same unit system shall be compatible with the mechanical and electrical characteristics of each of the other components of the unit system specified.
- D. Motor starter unit components shall be in accordance with NEMA standards.
- E. Starters for other than packaged equipment shall be provided as a part of the equipment and meet Division 16 Specification Sections.
- F. Approved Starter Manufacturers – Allen-Bradley, Cutler-Hammer, General Electric, Square D.

2.3 DISCONNECT SWITCHES

- A. Fusible Switches – Fused, each phase; general duty; horsepower rated; non-feasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro-silver plated current carrying parts; hinged doors; operating lever arranged for locking in the “OPEN” position; arc quenchers; capacity and characteristics shall be adequate for the equipment.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART ONE GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
- B. Product Data: For each type of product indicated.

PART TWO PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Standard: ASME B40.200.
 - 2. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
 - 3. Case Form: Adjustable angle unless otherwise indicated.
 - 4. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 6. Window: Glass.
 - 7. Stem: Aluminum and of length to suit installation.
 - 8. Design for Thermowell Installation: Bare stem.
 - 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 - 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.02 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR or CUNI.
 - 4. Type: Stepped shank unless straight or tapered shank is indicated.
 - 5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 - 6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 - 7. Bore: Diameter required to match thermometer bulb or stem.
 - 8. Insertion Length: Length required to match thermometer bulb or stem.
 - 9. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

PART THREE EXECUTION

3.01 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic coil in air-handling units.

3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
 - 1. Industrial-style, liquid-in-glass type.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING**PART ONE GENERAL**

1.01 SUMMARY

- A. Section Includes:
1. Bronze ball valves.
 2. Bronze swing check valves.
 3. Iron swing check valves.
 4. Bronze gate valves.
 5. Iron gate valves.
 6. Bronze globe valves.
 7. Iron globe valves.
 8. Drain valves.
 9. Balancing valves.

1.02 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.03 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART TWO PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Handwheel: For valves other than quarter-turn types.
 2. Handlever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Solder Joint: With sockets according to ASME B16.18.
 3. Threaded: With threads according to ASME B1.20.1.

2.02 BRONZE BALL VALVES

GENERAL DUTY VALVES FOR HVAC PIPING

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.03 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.04 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.05 BRONZE GATE VALVES

A. Class 125, RS Bronze Gate Valves:

1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.06 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves:

1. Description:

GENERAL DUTY VALVES FOR HVAC PIPING

- a. Standard: MSS SP-70, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

2.07 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.

2.08 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.09 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves.
- B. Standard: MSS SP-110 for standard-port, two-piece ball valves.
- C. Pressure Rating: 400-psig minimum CWP.
- D. Size: NPS 3/4.
- E. Body: Copper alloy.
- F. Ball: Chrome-plated brass.
- G. Seats and Seals: Replaceable.
- H. Handle: Vinyl-covered steel.
- I. Inlet: Threaded or solder joint.
- J. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 BALANCING VALVES

- A. Calibrated Balancing Valves - Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
 1. Available Manufacturers:
 - a. Griswold (BASIS OF DESIGN)
 - b. Amtrol, Inc.
 - c. Armstrong Pumps, Inc.
 - d. Armstrong-Yoshitake, Inc.

- e. Flow Design, Inc.
 - f. ITT Industries; Bell & Gossett Div.
 - g. ROMAC Industries, Inc.; Hays Fluid Control Div.
 - h. Tour & Andersson, Inc.
 - i. Watts Industries, Inc.; Water Products Div.
2. NPS 2 and Smaller – Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
 3. NPS 2 ½ and Larger – Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.

PART THREE EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball, butterfly valves.
 2. Throttling Service, Except Steam: Globe valves.
 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring.

- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.05 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, bronz.
 - 3. Bronze Swing Check Valves: Class 125, bronze disc.
 - 4. Bronze Gate Valves: Class 125, RS.
 - 5. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 and larger: 200 CWP, EPDM seat, aluminum-bronze disc.
 - 3. Iron Swing Check Valves: Class 125, metal seats.
 - 4. Iron Gate Valves: Class 125, OS&Y.
 - 5. Iron Globe Valves, NPS 2-1/2 and larger: Class 125.

END OF SECTION 230523

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Duct labels.
 5. Valve tags.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Labels for Equipment:
1. Material: Brass, stainless steel, aluminum, anodized aluminum, or multilayer, multicolor, plastic, and having predrilled or stamped holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: White.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material: Same as equipment labels.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch or stainless steel, 0.025-inch or aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain.
- B. Valve Tag Contents: Include identification of valve using same designations or abbreviations as used on Drawings; also include zone identification, valve model number, size, and rate flow in GPM.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099100 "Painting."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Refrigerant Piping: White letters on a green background.
 - 2. Equipment Drains: White letters on a brown background.
 - 3. Gas Piping: Black letters on a yellow background.
 - 4. Hot Water Supply from Boiler: Black letters on an orange background.
 - 5. Hot Water Return to Boiler: Black letters on an orange background.

3.5 DUCT LABEL INSTALLATION

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**PART ONE GENERAL**

1.01 DESCRIPTION

- A. Provide testing balancing and adjusting indicated
 - 1. Testing, balancing and adjusting air and water systems, including submains, branches and terminals to the indicated quantities according to specified tolerances.
 - 2. Measuring electrical performance of equipment.
 - 3. Setting quantitative performance of equipment.
 - 4. Verifying that automatic control devices are functioning properly.
 - 5. Measuring sound and vibration.
 - 6. Reporting results of TAB activities and procedures.

1.02 RELATED SECTIONS

- A. The following sections contain additional TAB requirements

1.03 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.04 SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

1.05 TAB reports.

- A. TAB Report Forms: Standard TAB contractor's forms approved by Architect.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.06 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

- B. TAB Conference: Meet with DMVA on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
1. Agenda Items:
 - a. The TAB plan.
 - b. Coordination and cooperation of trades and subcontractors.
 - c. Coordination of documentation and communication flow.
 - d. Certify TAB field data reports and perform the following:
 - e. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - f. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
 - g. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
 - h. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.07 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.08 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART TWO PRODUCTS (Not Used)

PART THREE EXECUTION

3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- G. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- H. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- I. Examine test reports specified in individual system and equipment Sections.
- J. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- L. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- O. Examine system pumps to ensure absence of entrained air in the suction piping.
- P. Examine operating safety interlocks and controls on HVAC equipment.
- Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check for proper sealing of air-handling unit components.
- J. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from DMVA for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.

3.06 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEM

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at design flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.07 HYDRONIC SYSTEM BALANCING PROCEDURES

- A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:
1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
 - C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
 - D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.
 - E. Adjust balancing stations to within specified tolerances of design flow rate as follows:
 1. Determine the balancing station with the highest percentage over design flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.
 3. Record settings and mark balancing devices.
 - F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.
 - G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.08 VARIABLE-FLOW HYDRONIC SYSTEM ADDITIONAL PROCEDURES

- A. Balance systems with automatic 2- and 3-way control valves by setting systems at maximum flow through terminals and proceed as specified above for hydronic systems.

3.09 PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEM ADDITIONAL PROCEDURES

- A. Balance the primary system crossover flow first, then balance the secondary system.

3.10 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating if high-efficiency motor.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.

3.11 CONDENSOR UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.12 BOILERS

- A. Measure entering- and leaving-water temperatures and water flow.

3.13 HEAT-TRANSFER COILS

- A. Water Coils - Measure the following data for each coil:
 1. Entering- and leaving-water temperatures.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperatures of entering and leaving air.
 5. Airflow.
 6. Air pressure drop.

3.14 TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate-drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.15 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.16 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.17 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Heating-Water Flow Rate: 0 to minus 10 percent.

3.18 REPORTING

- A. Initial Construction-Phase Report - Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to H&V systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports - As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.19 FINAL REPORT

TESTING, ADJUSTING AND BALANCING FOR HVAC

- A. General - Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents - In addition to the certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data - In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.
 - 3. Project name.
 - 4. Project location.
 - 5. Owner's name and address.
 - 6. Contractor's name and address.
 - 7. Report date.
 - 8. Signature of testing, adjusting, and balancing Agent who certifies the report.
 - 9. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 10. Nomenclature sheets for each item of equipment.
 - 11. Data for terminal units, including manufacturer, type size, and fittings.
 - 12. Notes to explain why certain final data in the body of reports vary from design values.
 - 13. Test conditions for fans and pump performance forms, including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams - Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
 - 1. Quantities of outside, supply, return, and exhaust airflows.
 - 2. Water flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
- F. Air-Handling Unit Test Reports - For air-handling units with coils, include the following:
 - 1. Unit Data - Include the following:

- a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
2. Motor Data - Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center and amount of adjustments in inches.
 3. Test Data - Include design and actual values for the following:
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Preheat coil, if equipped, static-pressure differential in inches wg.
 - f. Heating coil static-pressure differential in inches wg.
 - g. Outside airflow in cfm.
 - h. Return airflow in cfm.
 - i. Outside-air damper position.
 - j. Return-air damper position.
- G. Apparatus-Coil Test Reports -For apparatus coils, include the following:
1. Coil Data - Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 2. Test Data - Include design and actual values for the following:
 - a. Airflow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outside-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.

- H. Pump Test Reports - For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
1. Unit Data - Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 2. Test Data: Include design and actual values for the following:
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART ONE GENERAL

1.01 SUMMARY

- A. Section includes insulation for ductwork and HVAC piping.

1.02 SUBMITTALS:

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

PART TWO PRODUCTS

2.01 GENERAL

- A. Labeled with maximum flame-spread index of 25 and maximum smoke-developed index of 50 according to ASTM E 84.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.02 DUCT AND PLENUM INSULATION

- A. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK or FSP jacket.
 - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Blanket (Attic space): 3 inches thick and 0.75-lb/cu. ft. nominal density.
- B. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB with factory applied FSK jacket.
 - 1. Mineral-Fiber Blanket: 2 inches thick and 2 lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Blanket (Attic space): 3 inches thick and 2 lb/cu. ft. nominal density.
- C. Adhesives: Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- D. Insulation Pins and Hangers:
 - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
- E. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.03 PIPE & EQUIPMENT INSULATION

- A. Heating-Hot-Water Supply and Return: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation: Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ.
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inches thick.
- B. Refrigerant Suction and Hot-Gas Piping: Insulation shall be the following:
 - 1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I.
 - 2. Flexible Elastomeric: 1 inch thick.
- C. Mineral-Fiber, Pipe and Tank Insulation: Complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB; and having factory-applied ASJ. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
- D. Factory-Applied Jackets: When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- E. Adhesives: Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- F. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- G. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

PART THREE EXECUTION

3.01 INSTALLATION

- A. Comply with requirements of the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards" for insulation installation on pipes and equipment.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall, Partition, and Floor Penetrations: Install insulation continuously through penetrations. Seal penetrations. Comply with requirements in Section 078413 "Penetration Firestopping".
- D. Flexible Elastomeric Insulation Installation:
 - 1. Seal longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- E. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- F. Mineral-Fiber Insulation Installation:

1. Insulation Installation on Straight Pipes and Tubes: Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- G. Blanket and Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier.
- H. Plenums and Ducts Requiring Insulation:
1. Concealed and exposed supply and outdoor air.
 2. Concealed and exposed return air located in nonconditioned space.
 3. Concealed and exposed exhaust between isolation damper and penetration of building exterior.
- I. Plenums and Ducts Not Insulated:
1. Exposed metal ducts supply ducts not in attic space.
 2. Metal ducts with duct liner.
 3. Factory-insulated plenums and casings.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Factory-insulated access panels and doors.
- J. Piping Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawlspaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

END OF SECTION 230700

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS

PART ONE - GENERAL

1.1 SUMMARY

- A. This Section includes control equipment for HVAC systems and components.
- B. The Main HVAC Control Unit will be installed and Programmed by the contractor. The contractor shall provide and install all other components including end devices and wire to each of the points shown on the DRAWING SHEET M5 and specified in this specification.**

1.2 SUBMITTALS

- A. Product Data: For each control device indicated.
 - 1. Submittals shall be marked with Part Number.
- B. Shop Drawings:
 - 1. Schematic flow diagrams.
 - 2. Power, signal, and control wiring diagrams.
 - 3. Details of control panel faces.
 - 4. Damper schedule.
 - 5. Valve schedule.
 - 6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. The HVAC Control System shall be furnished, and installed by Licensed Trade Technicians. The contractor shall be an Echelon Certified Network Integrator or LonWorks Integrator. The contractor shall employ technicians who have completed Echelon factory authorized training. The contractor shall employ technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.
- B. The manufacturer of the hardware and software components must be primarily engaged in the manufacture of Lonworks based systems as specified herein, and must have been so for a minimum of three (3) years.
- C. The manufacturer of the hardware and software components as well as its subsidiaries must be a member in good standing of the LonMark Organization.
- D. The manufacturer of the hardware and software components shall have an authorized representative capable of providing service and support as referenced in section B above, and must have done so for a minimum of three (3) years.

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 ACCEPTANCE PROCEDURE

- A. Upon completion of the installation, Contractor shall start-up the system and perform all necessary calibration and testing to ensure proper operation of the project control systems.
- B. Schedule a hardware demonstration and system acceptance test in the presence of the Contracting Officer and/or the Engineer. The acceptance testing is defined as demonstrating the sequence of operation as indicated in the drawings. The hardware demonstration is specified in this Section. The Contractor shall perform all tests prior to scheduling the acceptance test and hardware demonstration to insure the overall system is ready for inspection and observations.
- C. When the system performance is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and be deemed substantially complete as defined in Division 1.

1.5 WARRANTY

- A. The HVAC Control System shall be free from defects in workmanship and material under normal use and service. If within eighteen (18) months from the date of substantial completion, the installed equipment is found to be defective in operation, workmanship or materials, the building systems contractor shall replace, repair or adjust the defect at no cost. Service shall be provided within 4 hours upon notice from Owner's designated Representative.
- B. The warranty shall extend to material that is supplied and installed by the Contractor. Material supplied but not installed by the Contractor shall be covered per the above to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Do not install electronic hardware in the project until non-condensing environmental conditions have been established. Products installed in violation of this request maybe requested to be replaced at no additional cost to the project.
- B. Coordinate storage requirements for factory mounted terminal control units on air terminal devices, air handling units or other packaged control equipment. Do not store control units on site in non-conditioned areas for more than two weeks.
- C. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

PART TWO – PRODUCTS

2.1 PRODUCTS GENERAL

- A. All products (PROGRAMMABLE CONTROLLER's, TDCU's and ID's) shall contain ANSI EIA 709.1 LonTalk Protocol networking elements to allow ease of integration of devices from multiple vendors.
- B. All materials, equipment and software shall be standard components, regularly manufactured for this and other systems and custom designed for this project. All systems and components shall be thoroughly tested.
- C. Control system components shall be new and in conformance with the following applicable standards for products specified:
 - 1. LonMark certified, and LNS Based.
 - 2. ANSI EIA 709.1 LonTalk Protocol
- D. Utilize standard PC components for all assemblies. Custom hardware, operating system, and utility software are not acceptable.
- E. All products (PROGRAMMABLE CONTROLLER's, TDCU's and ID's) shall contain ANSI EIA 709.1 LonTalk Protocol networking elements to allow ease of integration of devices from multiple vendors.
- F. All materials, equipment and software shall be standard components, regularly manufactured for this and other systems and custom designed for this project. All systems and components shall be thoroughly tested.

2.2 PROGRAMMING CONTROL UNIT AND PROGRAMMING SOFTWARE

- A. By Owner.

2.3 PROGRAMABLE UNIT CONTROLLERS (**DDC-1**)

- A. Basis of Design, subject to requirements provide products indicated on the DRAWINGS or pre-approved equal.

2.4 TRANSFORMER (**T-1**)

- A. Basis of Design, subject to requirements provide products indicated on the DRAWINGS or pre-approved equal.
 - 1. Provide with outlet.

2.5 DDC ENCLOSURE (**ENC-1**)

- A. Basis of Design, subject to requirements provide products indicated on the DRAWINGS or pre-approved equal.
 - 1. Provide with slotted wire duct and din rails as indicated on DRAWINGS.
 - 2. Coordinate with DMVA Control Technicians for Control Unit Mounting.

2.6 TEMPERATURE SENSORS AND TRANSMITTERS (**TEMP#**) (**OAT-1**)

- A. Basis of Design, subject to requirements provide products indicated on the DRAWINGS or pre-approved equal.

2.7 CO2 SENSOR (CO2-1)

- A. Basis of Design, subject to requirements provide products indicated on the DRAWINGS or pre-approved equal.

2.8 FREEZESTAT (FR-1)

- A. Basis of Design, subject to requirements provide products indicated on the DRAWINGS or pre-approved equal.

2.9 VALVE ACTUATORS (ACT-1)

- A. Basis of Design, subject to requirements provide products indicated on the DRAWINGS or pre-approved equal.

2.10 THERMOWELLS

- A. When thermowells are required, the sensor and well shall be supplied as a complete assembly including well head and greenfield fitting.
- B. Thermowells shall be pressure rated and constructed in accordance with the system working pressure
- C. Thermowells and sensors shall be mounted in a threadolet or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
- D. Thermowells shall be constructed of the following materials:
 - 1. Chilled and Hot Water; brass.

2.11 CURRENT TRANSFORMERS

- A. The current transformers shall be designed to be installed or removed without dismantling the primary bus or cables. The transformer shall be of a split core design.
- B. The core and windings shall be completely encased in a UL approved thermoplastic rated 94VA. No metal parts shall be exposed other than the terminals.
- C. The current transformers shall meet the following specifications:
 - 1. Frequency Limits: 50 to 400 Hz.
 - 2. Insulation: 0.6 KV Class, 10 KV BIL.
 - 3. Accuracy: \square 1% at 5.0 to 25.0 VA accuracy class with U.P.F. burden.
 - 4. Provide a disconnect switch for each current transformer.

2.12 ELECTRICAL CONTROL POWER AND LOW VOLTAGE WIRING

- A. Provide interlock wiring between supply and exhaust fans, electrical wiring for relays (including power feed) for temperature and pressure indication.
- B. Provide power wiring, conduit and connections for low temperature thermostats, high temperature thermostats, alarms, flow switches, actuating devices for temperature, humidity,

pressure and flow indication, point resets and user disconnect switches for electric heating, appliances controlled by this Section.

- C. Provide all other wiring required for the complete operation of the specified systems.
- D. Install all wiring raceway systems complying with the requirements of the National Electrical Code. All installations shall be installed in EMT.
- E. Network Communication Requirements
 1. Wired network communication shall be via channels consisting of a 22 AWG twisted pair installed in a 3/4 EMT. **Echelon approved wire only**
 2. In all communication conduits, provide one spare twisted pair to be installed, tagged and labeled at each end.
 3. Communication conduits shall not be installed closer than six feet from high power transformers or run parallel within six feet of electrical high power cables. Care shall be taken to route the cable as far from interference generating devices as possible.
 4. All shields shall be ground (earth ground) at one point only, to eliminate ground loops.
 5. There shall be no power wiring, in excess of 30 VAC rms, run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, all communication wiring and signal wiring shall be run using separate twisted shielded pairs (22awg) with the shields grounded in accordance with the manufacturer's wiring practices.
- F. Input/Output Control Wiring
 1. RTD wiring shall be two-wire or four-wire twisted, shielded, minimum number 18 gauge.
 2. Other analog inputs shall be a minimum of number 18 gauge, twisted, shielded.
 3. Binary control function wiring shall be a minimum of number 18 gauge.
 4. Analog output control functions shall be a minimum of number 18 gauge, twisted, shielded.
 5. Binary input wiring shall be a minimum of number 18 gauge.
- G. Splices
 1. Splices in shielded cables shall consist of terminations and the use of shielded cable couplers, which maintain the integrity of the shielding. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties as specified herein.
- H. Conduit and Fittings
 1. Conduit for Control Wiring, Control Cable and Transmission Cable: Electrical metallic tubing (EMT) with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections, Minimum size 3/4".
 2. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
 3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.
 4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.
- I. Relays
 1. Relays other than those associated with digital output cards shall be general purpose, enclosed plug-in type with 8-pin octal plug and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.

- J. Solid State Relays (SSR): Input/output isolation shall be greater than IOE9 ohms with a breakdown voltage of 1500V root mean square or greater at 60 Hz. The contact life shall be 10×10^6 operations or greater. The ambient temperature range of SSRs shall be -20 to +140F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release time shall be for 100 milliseconds or less. Transient suppression shall be provided as an integral part of the relay.
- K. Contactors: Contactors shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi permanent magnets. Contractor shall be double-break-silver-to-silver type protected by arcing contacts. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

2.13 IDENTIFICATION

- A. Automatic Control Valve Tags
 1. For valves, etc., use metal tags with a 2-inch minimum diameter, fabricated of brass, stainless steel or aluminum. Attach tags with chain of same materials. For lubrication instructions, use linen or heavy duty shipping tag.
 2. Tag valves with identifying number and system. Number valves by floor level, column location and system served.
 3. Prepare lists of all tagged valves showing location, floor level, and tag number, use. Prepare separate lists for each system. Include copies in each maintenance manual. And post in boiler room.
- B. Wire Tags
 1. All multi-conductor cables in pull boxes, at end devices, controllers and terminal strip cabinets shall be labeled.
 2. Provide wire Tags as per Division 16.
- C. Conduit Tags
 1. Provide tagging or labeling of conduit so that it is always readily observable which conduit was installed or used in implementation of this Work.
- D. Miscellaneous Equipment Identification
 1. Screwed-on, engraved black lamicaid sheet with white lettering on all control panels and remote processing panels. Lettering sizes subject to approval.
 2. Inscription, subject to review and acceptance, indicating equipment, system numbers, functions and switches. For panel interior wiring, input/output modules, local control panel device identification.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that systems are ready to receive work.
- B. Beginning of installation means installer accepts existing conditions.

- C. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- D. The contractor shall inspect the site to verify that equipment is installable as show, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- E. The Control System Contractor shall examine the drawings and specifications for other parts of the work, and if head room or space conditions appear inadequate or if any discrepancies occur between the plans and his work and the plans for the work of others, he shall report such discrepancies to the Architect/Engineer and shall obtain written instructions for any changes necessary to accommodate his work with the work of others.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install all control components in accordance with manufacturer's instructions and recommendations.
- B. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide nameplates for instruments and controls inside cabinet and nameplates on cabinet face.
- C. After completion of installation, test and adjust control equipment. Submit data showing setpoints and final adjustments of controls.
- D. Install equipment, piping, wiring/conduit parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- E. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- F. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- G. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
- H. All communication switches and shelves for equipment will be installed by this contractor.
- I. **All setup of IP addresses will be completed by DMVA. Leave all web servers at static IP.**

3.3 ELECTRICAL SYSTEM INSTALLATION

- A. Install all low voltage power and LON and LAN communication trunks in conduit regardless of local building code allowances otherwise.
- B. Conceal conduit within finished shafts, ceilings and wall as required. Install exposed conduit parallel with or at right angles to the building walls.

- C. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
 - 1. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
 - 2. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.
- D. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- E. Plug or cap all unused conduit openings and stub-ups. Do not use caulking compound.
- F. Route all conduit to clear beams, plates, footings and structure members. Do not route conduit through column footings or grade beams.
- G. Set conduits as follows:
 - 1. Expanding silicone fire stop material sealed watertight where conduit is run between floors and through walls of fireproof shaft.
 - 2. Oakum and lead, sealed watertight penetration through outside foundation walls.
- H. Cap open ends of conduits until conductors are installed.
- I. Where conduit is attached to vibrating or rotating equipment, flexible metal conduit with a minimum length of 18 inches and maximum length of 36 inches shall be installed and anchored in such a manner that vibration and equipment noise will not be transmitted to the rigid conduit.
- J. Where exposed to the elements or in damp or wet locations, waterproof flexible conduit shall be installed. Installation shall be as specified for flexible metal conduit.
- K. Provide floor, wall, and ceiling plates for all conduits passing through walls, floors or ceilings. Use prime coated cast iron, split-ring type plates, except with polished chrome-plated finish in exposed finished spaces.

3.4 TEMPERATURE SENSORS

- A. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application in such manner as to allow for quick, easy replacement and servicing without special tools or skills.
- B. Strap-on mountings shall not be permitted.
- C. Outdoor installations shall be; of weatherproof construction or in appropriate NEMA enclosures. These installations shall be protected from solar radiation and wind effects. Protective shield shall be stainless steel.
- D. Sensors shall be with enclosure where located in finished space.

- E. Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only and shall not be located in dead air spaces or positions obstructed by ducts, equipment, and so forth. Locations where installed shall be within the vibration and velocity limit of the sensing element. Ducts shall be securely sealed where elements or connections penetrate ducts to avoid measuring false conditions.
- F. All sensors measuring temperatures in pipes larger than 2 inches in diameter or in pressure vessels shall be supplied with wells properly fabricated for the service. Wells shall be noncorrosive to the medium being measured and shall have sufficient physical strength to withstand pressures and velocities to which they are subjected. Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to affect proper flow across the entire area of the well.

3.5 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
- B. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.6 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling including that within factory-fabricated panels shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1 inch letters on nameplates.
- D. Identify all other control components with permanent labels. Identifiers shall match record documents.
- E. Identify room sensors relating to terminal box or valves with nameplates.

3.7 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match

the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.8 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on-site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.9 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and/or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.10 CHECK OUT, START UP AND TESTING

- A. The control system shall be properly commissioned prior to acceptance. The Contractor shall coordinate with others (including mechanical, electrical and test and balance) to properly start up and verify the operation of the system. Provide as-built documentation as detailed in Part 1 of this Section.

3.11 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

END OF SECTION 230900

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART ONE - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Pipes, tubes, and fittings.
 2. Piping and tubing joining materials.
 3. Valves.

1.02 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 2. Service Regulators: 65 psig minimum unless otherwise indicated.
- B. The new gas service line installation from the main tie-in on the existing main up to and including the regulator must be installed by a DTE approved subcontractor.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

PART TWO - PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

2.02 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.

2.03 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 4. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
 2. Ball: Chrome-plated bronze.
 3. Stem: Bronze; blowout proof.

4. Seats: Reinforced TFE; blowout proof.
5. Packing: Threaded-body packnut design with adjustable-stem packing.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. CWP Rating: 600 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.04 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.05 HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel

PART THREE – EXECUTION

3.01 PIPING INSTALLATION

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Locate valves for easy access.
- G. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.

- J. Verify final equipment locations for roughing-in.
- K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- L. Drips and Sediment Traps: Install drips at points where condensate may collect. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- N. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- O. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- P. Do not use natural-gas piping as grounding electrode.
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- R. Paint all natural gas piping safety yellow, see Section 099100 "Painting".

3.02 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead each piece of equipment

3.03 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.04 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3.05 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.06 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.07 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Copper tube and fittings.
 - 2. Steel pipe and fittings.
 - 3. Joining materials.
 - 4. Transition fittings.
 - 5. Dielectric fittings.

1.2 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pipe.
 - 2. Fittings.
 - 3. Joining materials.
- B. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Other building services.
 - 3. Structural members.
- C. Welding certificates.
- D. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS**2.1 COPPER TUBE AND FITTINGS**

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Copper or Bronze Pressure-Seal Fittings:
 - 1. Housing: Copper.
 - 2. O-Rings and Pipe Stops: EPDM.
 - 3. Tools: Manufacturer's special tools.
 - 4. Minimum 200-psig working-pressure rating at 250 deg F.
- C. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- D. DWV Copper Tubing: ASTM B 306, Type DWV.
- E. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2. Couplings: Ductile- or malleable-iron housing and EPDM or nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
 2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 1. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 deg F.

- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
- 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
- 1. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig at 225 deg F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed or pressure sealed joints.
 - 2. Schedule 40, Grade B steel pipe; Class 125, cast-iron or Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
- 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Hot-water heating piping installed belowground and within slabs shall be the following:
- 1. Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered or brazed joints. Use the fewest possible joints.
- D. Makeup-water piping installed aboveground shall be the following:
- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed or pressure sealed joints.
- E. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- F. Condensate-Drain Piping installed aboveground shall be the following:
- 1. Type M, drawn-temper copper tubing, wrought-copper fittings, pressure sealed and soldered joints.

- G. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- H. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- I. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

- P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors.
- V. Install sleeve seals for piping penetrations of concrete walls and slabs.
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet.
 - 2. NPS 1: Maximum span, 7 feet.
 - 3. NPS 1-1/2: Maximum span, 9 feet.
 - 4. NPS 2: Maximum span, 10 feet.
 - 5. NPS 2-1/2: Maximum span, 11 feet.
 - 6. NPS 3 and Larger: Maximum span, 12 feet.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set makeup pressure-reducing valves for required system pressure.
 - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 5. Set temperature controls so all coils are calling for full flow.
 - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 - 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART ONE GENERAL

1.01 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Makeup-water piping.
 - 3. Condensate-drain piping.
 - 4. Blowdown-drain piping.
 - 5. Air-vent piping.
 - 6. Safety-valve-inlet and -outlet piping.

1.02 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.
- B. Operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART TWO PRODUCTS

2.01 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping".
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "HVAC Instrumentation and Controls" and DRAWINGS.
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 2. Ball: Brass or stainless steel.
 - 3. Plug: Resin.
 - 4. Seat: PTFE.
 - 5. End Connections: Threaded or socket.
 - 6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 7. Handle Style: Lever, with memory stop to retain set position.
 - 8. CWP Rating: Minimum 125 psig.
 - 9. Maximum Operating Temperature: 250 deg F.
- D. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
 - 1. Body: Bronze or brass.

2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Low inlet-pressure check valve.
7. Inlet Strainer: removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

E. Diaphragm-Operated Safety Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Wetted, Internal Work Parts: Brass and rubber.
7. Inlet Strainer: removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Automatic Flow-Control Valves:

1. Automatic Flow Control Valves - Class 350, cast iron housing, stainless steel operating parts; threaded connections for 2 inch and smaller, flanged connections for 2-1/2 inch and larger. Factory set to automatically control flow rates within plus or minus 5 percent design, while compensating for system operating pressure differential. Provide quick disconnect valves for flow measuring equipment. Provide a metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, size, and rate flow in GPM.

2.02 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

B. Expansion Tanks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product **indicated on DRAWINGS** or comparable product.
 - a. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - b. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 10-gal.unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.

- c. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
 - d. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch-diameter gage glass, and slotted-metal glass guard.
- C. Air Dirt Separator – **as indicated on Drawings**, steel body; ASME constructed and labeled for minimum 125 psig water working pressure and 250 F operating temperature; flanged connections for 1-1/2 inch NPS and above; sized as indicated for full system flow capacity; brass automatic air vent body; brass dirt separation chamber w/ drain shutoff valve.
- D. In-Line Air Separators:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product **indicated on DRAWINGS** or comparable product.
 - a. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
 - b. Maximum Working Pressure: Up to 175 psig.
 - c. Maximum Operating Temperature: Up to 300 deg F.

2.03 HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:
- 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
 - 4. CWP Rating: 125 psig.

PART THREE EXECUTION

3.01 VALVE APPLICATIONS

- A. Install shutoff duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install calibrated plug valves on the outlet of each heating element and elsewhere as required to facilitate system balancing.
- E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.
- F. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- G. Install pump discharge valves with stem in upward position; allow clearance above stem for check mechanism removal.
- H. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

- I. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- D. Install strainer in pump suction lines.
- E. Install blowdown piping with gate valve; extend to nearest drain.
- F. Install expansion tank as indicated.
- G. Install glycol make up system as indicated by manufacturer. Fill system to 30% concentration.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

PART ONE GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Close-coupled, in-line centrifugal pumps.
 2. Separately coupled in-line centrifugal pumps.

1.02 SUBMITTALS

- A. Product Data: For each type of pump.
- B. Shop Drawings: For each pump.
1. Show pump layout and connections.
 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 3. Include diagrams for power, signal, and control wiring.
- C. Operation and maintenance data.

PART TWO PRODUCTS

2.01 IN-LINE CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product. available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Armstrong Pumps Inc.
 2. Aurora Pump; Division of Pentair Pump Group.
 3. Bell & Gosset.
 4. Crane Pumps & Systems.
 5. Grundfos Pumps Corporation.
 6. ITT Corporation; Bell & Gossett.
 7. Peerless Pump Company.
- B. Description:
1. Pumps (**as indicated on DRAWINGS**)
 - a. Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
 2. Motor:
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - b. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Electrical Requirements for HVAC Equipment".
 3. Capacities and Characteristics as indicated on DRAWINGS.

PART THREE EXECUTION

3.01 PUMP INSTALLATION

- A. Comply with HI 1.4.

HYDRONIC PUMPS

- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Equipment Mounting: Install in-line pumps per manufacturer's recommendations to support weight of in-line pumps.

3.02 ALIGNMENT

- A. Perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.03 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install shutoff valve and strainer on pump suction and check valve and shutoff valve on pump discharge, except where other arrangement is indicated.
- F. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 232123

SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes pipe and fittings for LP steam and condensate piping:
 - 1. Steel pipe and fittings.
 - 2. Fiberglass pipe and fittings.
 - 3. Joining materials.
- B. Related Requirements:
 - 1. Section 232216 "Steam and Condensate Heating Piping Specialties" for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

1.2 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Steel pipe and fitting.
 - 2. Joining material.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify procedures and operators according to the following:
 - 1. ASME Compliance: Comply with ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 - 1. LP Steam Piping: 15 psig.
 - 2. Condensate Piping: 80 psig at 250 deg F.
 - 3. Makeup-Water Piping: 80 psig at 150 deg F.
 - 4. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
 - 5. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.

6. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, welded and seamless, Grade B, and Schedule as indicated in piping applications articles.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in piping applications articles.
- C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in piping applications articles.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in piping applications articles.
- E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in piping applications articles; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

PART 3 - EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

- A. LP Steam Piping, NPS 2 and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- B. LP Steam Piping, NPS 2-1/2 through NPS 12: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- C. Condensate piping above grade, NPS 2 and smaller, shall be the following:
 - 1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- D. Condensate piping above grade, NPS 2-1/2 and larger, shall be the following:
 - 1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- E. Condensate piping below grade, NPS 2 and smaller, shall be either of the following:
 - 1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- F. Condensate piping below grade, NPS 2-1/2 and larger, shall be the following:
 - 1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.2 ANCILLARY PIPING APPLICATIONS

- A. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- B. Vacuum-Breaker Piping: Outlet, same as service where installed.
- C. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping free of sags and bends.

- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- K. Install drains, consisting of a tee fitting, NPS ¾ full port-ball valve, and short NPS ¾ threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe.
- P. Install valves according to the following Sections or other Sections as needed:
 - 1. Section 230523.11 "Globe Valves for HVAC Piping."
 - 2. Section 230523.12 "Ball Valves for HVAC Piping."
 - 3. Section 230523.13 "Butterfly Valves for HVAC Piping."
 - 4. Section 230523.14 "Check Valves for HVAC Piping."
 - 5. Section 230523.15 "Gate Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS ¾ nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- U. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- V. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- W. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.
2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

X. Install sleeves for piping penetrations of walls, ceilings, and floors.

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 STEAM AND CONDENSATE PIPING SPECIALTIES INSTALLATION

- A. Comply with requirements in Section 232216 "Steam and Condensate Heating Piping Specialties" for installation requirements for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

3.5 HANGERS AND SUPPORTS

- A. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

- B. Install hangers for steel steam supply piping with the following maximum spacing:

1. NPS 3/4: Maximum span, 9 feet.
2. NPS 1: Maximum span, 9 feet.
3. NPS 1-1/2: Maximum span, 12 feet.
4. NPS 2: Maximum span, 13 feet.
5. NPS 2-1/2: Maximum span, 14 feet.
6. NPS 3 and Larger: Maximum span, 15 feet.

- C. Install hangers for steel steam condensate piping with the following maximum spacing:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

- D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.6 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install traps and control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install vacuum breakers downstream from control valve, close to coil inlet connection.
- E. Install a drip leg at coil outlet.

3.8 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
- B. Perform the following tests and inspections
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
 - 3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

C. Prepare test and inspection reports.

END OF SECTION 232213

SECTION 232216 - STEAM AND CONDENSATE HEATING PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following piping specialties for steam and condensate piping:
1. Strainers.
 2. Stop-check valves.
 3. Safety valves.
 4. Pressure-reducing valves.
 5. Steam traps.
 6. Thermostatic air vents.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to the following:
1. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 STRAINERS

- A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
 3. Strainer Screen: Stainless-steel, **20**-mesh strainer or perforated stainless-steel basket.
 4. Tapped blowoff plug.
 5. CWP Rating: 250-psig working steam pressure.
- B. Basket Strainers:
1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
 3. Strainer Screen: Stainless-steel, **20**-mesh strainer and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 250-psig working steam pressure.

2.2 STOP-CHECK VALVES

A. Stop-Check Valves:

1. Body and Bonnet: Malleable iron.
2. End Connections: Flanged.
3. Disc: Cylindrical with removable liner and machined seat.
4. Stem: Brass alloy.
5. Operator: Outside screw and yoke with cast-iron handwheel.
6. Packing: PTFE-impregnated packing with two-piece packing gland assembly.
7. Pressure Class: 250.

2.3 STEAM SAFETY VALVES

A. Bronze or Brass Steam Safety Valves: ASME labeled.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Kunkle Valve; a Tyco International Ltd. Company.
 - c. Spirax Sarco, Inc.
 - d. Watts Water Technologies, Inc.
2. Disc Material: Forged copper alloy.
3. End Connections: Threaded inlet and outlet.
4. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet, with threads complying with ASME B1.20.1.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Cast-Iron Steam Safety Valves: ASME labeled.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Kunkle Valve; a Tyco International Ltd. Company.
 - c. Spirax Sarco, Inc.
 - d. Watts Water Technologies, Inc.
2. Disc Material: Forged copper alloy with bronze nozzle.
3. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
4. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
7. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
8. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.4 STEAM TRAPS

A. Float and Thermostatic Steam Traps:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. Dunham-Bush, Inc.
 - d. Hoffman Specialty; Division of ITT Industries.
 - e. Spirax Sarco, Inc.
 - f. Sterling.
2. Body and Bolted Cap: ASTM A 126 cast iron.
3. End Connections: Threaded.
4. Float Mechanism: Replaceable, stainless steel.
5. Head and Seat: Hardened stainless steel.
6. Trap Type: Balanced pressure.
7. Thermostatic Bellows: Stainless steel or monel.
8. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless-steel cage, valve, and seat.
10. Maximum Operating Pressure: 125 psig.

2.5 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. Dunham-Bush, Inc.
 - d. Hoffman Specialty; Division of ITT Industries.
 - e. Spirax Sarco, Inc.
 - f. Sterling.
2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Float, Valve, and Seat: Stainless steel.
5. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

- B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.2 PIPING INSTALLATION

- A. Install piping to permit valve servicing.
- B. Install drains, consisting of a tee fitting, NPS 3/4 full-port ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- C. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment and elsewhere as indicated.
- D. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full-port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

3.3 STEAM-TRAP INSTALLATION

- A. Install steam traps in accessible locations as close as possible to connected equipment.
- B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.4 PRESSURE-REDUCING VALVE INSTALLATION

- A. Install pressure-reducing valves in accessible location for maintenance and inspection.
- B. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.
- C. Install gate valves on both sides of pressure-reducing valves.
- D. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections, respectively.
- E. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection.
- F. Install strainers upstream for pressure-reducing valve.
- G. Install safety valve downstream from pressure-reducing valve station.

3.5 SAFETY VALVE INSTALLATION

- A. Install safety valves according to ASME B31.9, "Building Services Piping."
- B. Pipe safety-valve discharge without valves to atmosphere outside the building.
- C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
- D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Install traps and control valves in accessible locations close to connected equipment.
- B. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- C. Install vacuum breakers downstream from control valve, close to coil inlet connection.

END OF SECTION 232216

SECTION 232500 - HYDRONIC WATER TREATMENT**PART 1 - GENERAL**

1.0 DESCRIPTION

- A. Section includes the following water treatment for closed-loop hydronic systems:
 - a. Boiler make up tank.
 - b. Chemicals.

1.1 SUBMITTALS

- A. Product Data - Include manufacturer's technical product data, rated capacities of selected equipment clearly indicated, water-pressure drops, weights (shipping, installed, and operating), and furnished products listed below:
 - 1. Boiler make-up tank.
 - 2. Chemicals.

1.2 CLOSED-LOOP (HYDRONIC) WATER TREATMENT

- A. Contractor will introduce chemical treatment into the system after system is cleaned as per paragraph 3.1 CLEANING.

1.3 CONTRACTOR'S MAINTENANCE - To include the following:

- A. Scope of Service: Provide chemicals and service program to maintain water conditions required to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall include the following:
 - 1. Initial water analysis and HVAC water-treatment recommendations.
 - 2. Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

2.2 BOILER MAKE-UP TANK

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Bell & Gossett Division of ITT Industries
 - 2. John Wood Company
 - 3. Patterson Pump Company
 - 4. Wessels

- B. Description: Package shall consist of a base, polyethylene reservoir with removable lid and visible solution level scale in gallons and liters, y-strainer, isolation valve, pump, open drip-proof motor, pump isolation, check and balance valve, expansion tank, discharge pressure gage, motor contactor, pressure control and necessary interconnecting piping.
- C. Operation: Pump shall start based on falling pressure.
- D. System shall include:
 - 1. 115/1/60 single power connection
 - 2. 3/4" NPT system piping connection
 - 3. Green light on control panel shall indicate power supplied to unit.
 - 4. Low level cutout, with red indicator light on control panel and 110V contact for alarm indication, to stop the pump during low level condition.

2.3 CHEMICALS

- A. System Cleaner - Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
 - 1. Quantity – Provided by Contractor at quantity required for complete cleaning by DMVA.
 - 2. Enerco 9646 solution.
- B. Closed Loop Water Piping Chemicals - Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors, and conductivity enhancers.
 - 1. Enerco 9906 solution.

PART 3 - EXECUTION

3.1 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, repair damaged finishes including chips, scratches and abrasions.
- B. Ensure that system is operational.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
 - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 - 5. Test for leaks and defects.
 - 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 7. Cap and subject piping to static water pressure of 50 psig above operating pressure without exceeding pressure rating of piping system materials. Isolate

test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.

8. Repair leaks and defects with new materials and retest piping until satisfactory results are obtained.
9. Prepare test reports, including executed corrective action.

END OF SECTION 232500

SECTION 233113 – METAL DUCTS

PART ONE - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Rectangular metal ducts and fittings.
 2. Round metal ducts and fittings.
 3. Sheet metal materials.
 4. Sealants and gaskets.
 5. Hangers and supports.

1.02 SUBMITTALS

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

1.03 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART TWO - PRODUCTS

2.01 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.04 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.05 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

PART THREE - EXECUTION

3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.[]

3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

- A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 7. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 8. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 9. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 10. Conditioned Space, Return-Air Ducts: Seal Class C.

3.04 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

- E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 CONNECTIONS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Balancing, and Adjusting for HVAC".

3.07 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Pressure Class: Positive 1-inch wg.
 - 2. Minimum SMACNA Seal Class: A.
 - 3. SMACNA Leakage Class for Rectangular: 12.
 - 4. SMACNA Leakage Class for Round and Flat Oval: 12.
- B. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- C. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - b. Radius-to Diameter Ratio: 1.5.
 - c. Round Elbows: Stamped or pleated.
- D. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - 2. Rectangular Main to Rectangular Branch: 45-degree entry.
 - 3. Rectangular Main to Round Branch: Spin in.
 - 4. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees."

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES**PART ONE GENERAL****1.01 SUMMARY**

- A. Provide duct accessories indicated.
 - 1. Manual volume control dampers.
 - 2. Fire dampers.
 - 3. Ceiling fire dampers.
 - 4. Turning vanes.
 - 5. Duct-mounting access doors.
 - 6. Flexible connectors.
 - 7. Duct accessories hardware.

1.02 SUBMITTALS

- A. Product Data including details for materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Backdraft dampers.
 - 2. Manual volume control dampers.
 - 3. Motorized control dampers.
 - 4. Ceiling fire dampers.
 - 5. Turning vanes.
 - 6. Duct-mounting access doors.
 - 7. Flexible connectors.
 - 8. Flexible ducts.
- B. Shop Drawings – Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Special fittings.
 - 2. Manual-volume damper installations.
 - 3. Motorized-control damper installations.
 - 4. Fire-damper, smoke-damper, and combination fire- and smoke damper installations, including sleeves and duct-mounting access doors.
 - 5. Wiring Diagrams – Power, signal, and control wiring.
- C. Coordination Drawings – Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.03 QUALITY ASSURANCE

- A. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

1.04 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links – Furnish quantity equal to 10% of amount installed, but not less than one item of each different link installed.

PART TWO MATERIALS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers – Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product – Subject to compliance with requirements, provide the product indicated on Drawings or an approved comparable product

2.02 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards—Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel - Lock-forming quality, complying with ASTM A 653, and having G90 coating designation; ducts shall have mill phosphatized finish for surfaces exposed to view.
- C. Carbon-Steel Sheets – ASTM A 366, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- D. Reinforcement Shapes and Plates – Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- E. Tie Rods - Galvanized steel, 1/4" minimum diameter for 36" length or less; 3/8" minimum diameter for lengths longer than 36".

2.03 MANUAL-VOLUME DAMPERS

- A. Available Manufacturers:
 - 1. Air Balance, Inc.
 - 2. American Warming and Ventilating.
 - 3. Flexmaster U.S.A., Inc.
 - 4. McGill AirFlow Corporation.
 - 5. METALAIRE, Inc.
 - 6. Nailor Industries Inc.
 - 7. Penn Ventilation Company, Inc.
 - 8. Ruskin Company.
 - 9. Vent Products company, Inc.
- B. General Description – Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Pressure Classes of 3-Inch wg or Higher – end bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- C. Standard Volume Dampers – Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.
- D. Low-Leakage Volume Dampers – Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating and suitable for horizontal or vertical applications.

AIR DUCT ACCESSORIES

2.04 FIRE DAMPERS

A. Available Manufacturers – Basis-of-design was by National Controlled Air, Inc.:

1. Air Balance, Inc.
2. CESCO Products
3. Greenheck
4. McGill AirFlow Corporation
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. National Controlled Air, Inc.
8. Penn Ventilation Company, Inc.
9. Prefco products, Inc.
10. Ruskin Company
11. Vent Products Company, Inc.
12. Ward Industries, Inc.

B. Description

1. Fire dampers shall be labeled according to UL Standard 555 "Standard for Fire Dampers."
2. Fire Rating - 3 hours.
3. Frame –Curtain type with blades outside airstream; fabricated with roll-formed, 0.034" thick, galvanized-steel; with mitered and interlocking corners.
4. Mounting Sleeve - Factory-installed for field-installed galvanized sheet steel.
 - a. Minimum Thickness - 0.056" (16 gauge) or 0.138" (10 gauge) thick as indicated, and length to suit application.
 - b. Exceptions - Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of the wall or floor, and thickness of damper frame meets sleeve requirements.
5. Mounting Orientation - Vertical or horizontal as indicated.
6. Blades - Roll-formed, interlocking, 21-gauge galvanized steel. In place of interlocking blades, provide full-length, 21-gauge, galvanized steel blade connectors.
7. Horizontal Dampers – Curtain type, include a blade lock and stainless steel negator closure spring.
8. Fusible Link - 165 deg F deg F.

2.05 CEILING FIRE DAMPERS

A. Available Manufacturers:

1. Air Balance, Inc.
2. CESCO Products
3. Greenheck
4. McGill AirFlow Corporation
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. National Controlled Air, Inc.
8. Penn Ventilation Company, Inc.
9. Prefco products, Inc.
10. Ruskin Company
11. Vent Products Company, Inc.
12. Ward Industries, Inc.

B. Description

1. Fire dampers shall be labeled according to UL Standard 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
2. Frame – Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
3. Blades - Galvanized sheet steel with ceramic blanket insulation..

4. Fusible Links – Replaceable, 165 deg F Rated.

2.06 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes - Fabricate 1-1/2-inch-wide vane, curved blades of galvanized sheet steel set 3/4 incho.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

2.07 DUCT-MOUNTING ACCESS DOORS

- A. Fabricate doors airtight and suitable for duct pressure class.
- B. Door - Double-wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include 1-by-1-inch butt or piano hinge and cam latches.
 1. Available Manufacturers:
 - a. Air Balance, Inc.
 - b. CESCO Products
 - c. Ductmate Industries, Inc.
 - d. Flexmaster U.S.A., Inc.
 - e. Greenheck
 - f. McGill AirFlow Corporation
 - g. Nailor Industries Inc.
 - h. Ventfabrics, Inc.
 - i. Ward Industries, Inc.
 2. Frame - Galvanized, sheet steel, with bend-over tabs and foam gaskets.
 3. Provide number of hinges and locks as follows:
 - a. Less Than 12" Square – Secure with two sash locks.
 - b. Up to 18" Square – Two hinges and two sash locks.
 - c. Up to 24" x 48" – Three hinges and two compression latches.
 - d. Sizes Larger than 24" x 48" – One additional hinge
- C. Door – Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1" thickness. Include cam latches.
 1. Available Manufacturers:
 - a. Flexmaster U.S.A., Inc.

2.08 FLEXIBLE CONNECTORS.

- A. Available Manufacturers:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Corp.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.
- B. Description
 1. Flame-retardant or noncombustible fabric, coatings and adhesives complying with UL 181, Class 1
 2. Metal-Edged Connectors - Factory-fabricated with a fabric strip 3 1/2" to 5-3/4" wide attached to 2 strips of 2 3/4" wide, 0.028" thick, galvanized sheet steel or 0.032" thick aluminum sheets; select meal compatible with ducts. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.

3. Indoor System, Flexible Connector Fabric – Glass fabric double coated with neoprene.
 - a. Minimum Weight – 26 oz/SY.
 - b. Tensile Strength – 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - c. Service Temperature – Minus 40 to plus 200 deg F.

2.09 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes - Cast iron or cast aluminum to suit duct material, including screw cap and gasket and a flat mounting gasket. Size to allow insertion of pilot tube and other testing instruments and length to suit duct insulation thickness.
- B. Adhesives - High strength, quick setting, neoprene based, waterproof and resistant to gasoline and grease.

PART THREE EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- E. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- F. Install fire and smoke dampers, with fusible links, according to the manufacturer's UL-approved written instructions.
- G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 1. On both sides of duct coils.
 2. Downstream from volume dampers, turning vanes, and equipment.
 3. Adjacent to fire or smoke dampers, providing access to reset and reinstall fusible links.
 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
 5. On both sides of ducts where adequate clearance is available.
- H. Install the following sizes for duct-mounting, rectangular access doors:
 1. One-Hand or Inspection Access – 8" x 5".
 2. Two-Hand Access – 12" x 6".
 3. Head and Hand Access – 18" x 10".
 4. Head and Shoulders Access – 21" x 14".
 5. Body Access – 25" x 14".
 6. Body Plus Ladder Access – 25" x 17".
- I. Install the following sizes for duct-mounting, round access doors:
 1. One-Hand or Inspection Access – 8" diameter.
 2. Two-Hand Access – 10' diameter.

3. Head and Hand Access – 12” diameter.
4. Head and Shoulders Access – 18” diameter.
5. Body Access – 24” diameter.

- J. Label access doors according to Section 230553 “Identification for HVAC Piping and Equipment”.
- K. Install flexible connectors immediately adjacent to equipment.
- L. For fans developing static pressures of 5” wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect terminal units to supply ducts directly or with maximum 12” lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffers boots to low pressure ducts directly or with maximum 60” lengths of flexible duct clamped or strapped in place.
- O. Install duct test holes where indicated and required for testing and balancing purposes.

3.02 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual dampers is specified in Section 230593 "Testing, Balancing, and Adjusting for HVAC."

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Provide and install exhaust fans indicated.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 EXHAUST FANS

- A. See Exhaust Fan on Mechanical Equipment Schedule on **DRAWINGS** or provide comparable product by one of the following:
 - 1. Broan-NuTone LLC.
 - 2. Carnes Company.
 - 3. Greenheck Fan Corporation.
 - 4. Loren Cook Company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install per manufacturer's instructions to operate as indicated.
- B. Install units with clearances for service and maintenance.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 2. Verify that cleaning and adjusting are complete.
 - 3. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, GRILLES

PART ONE GENERAL

1.01 DESCRIPTION

- A. Provide ceiling-and wall-mounted diffusers, registers, and grilles.

1.02 SUBMITTALS

- A. Product Data for each product indicated.
 - 1. Data Sheet – Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule – Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Coordination Drawings – Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, access panels, and special moldings.
 - 5. Duct access panels.

1.03 DEFINITIONS

- A. Diffusers – Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille – A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register – A combination grille and damper assembly over an air opening.

1.04 QUALITY ASSURANCE

- A. Product Options – Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the system indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to INSTRUCTIONS TO BIDDERS, "Substitutions" paragraph.
- B. NFPA Compliance – Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems.

PART TWO PRODUCTS – See SCHEDULE on DRAWINGS SHEET M4.

PART THREE EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements of installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with work only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets – Drawings indicated general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify DMVA for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING – After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.04 CLEANING – After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hooded ventilators.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For gravity ventilators.
 - 1. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
 - 2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

1.3 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 FABRICATION

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.2 HOODED VENTILATORS

- A. Description: Hooded round penthouse for intake air.
- B. Basis-of-Design - Furnish and install **GREENHECK GRSI MODEL 12 WITH GRAVITY DAMPER**, gravity ventilator or an approved equal.
- C. Source Limitations: Obtain hooded ventilators from single manufacturer.
- D. Construction:

1. Material: Aluminum, of thickness required to comply with structural performance requirements, but not less than 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.
 2. Insulation: Mineral-fiber insulation and vapor barrier.
 3. Bird Screening: Aluminum, 1/2-inch- square mesh or flattened, expanded aluminum, 3/4-inch diamond mesh wire.
- E. Dampers:
1. Control: Gravity backdraft.
- F. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
 2. Overall Height: 12 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure gravity ventilators to roof curbs with zinc-plated. Use concealed anchorages where possible. Refer to Section 077200 "Roof Accessories."
- C. Install gravity ventilators with clearances for service and maintenance.
- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes, so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- I. Refer to Section 077200 "Roof Accessories" for flashing and counterflashing of roof curbs.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts". Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 235216 - CONDENSING BOILERS**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes gas-fired, condensing boilers, trim, and accessories for generating hot water.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Schematic flow diagram of gas valve trains.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 4. Include diagrams for power, signal, and control wiring.
 - a. Schematic control wiring diagram shall be ladder type showing all components, interlocks, etc. Schematic wiring diagram shall clearly identify factory wiring and field wiring.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Boiler Inspector's Certifications.
- F. Sample Warranty: For special warranty.
- G. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. The equipment shall, as a minimum, be in strict compliance with the requirements of this specification, shall perform as specified and shall be the manufacturer's standard commercial product unless specified otherwise.
- B. Electrically operated components specified are to be "Listed" and/or "Labeled" as defined by NFPA 70, Article 100.
- C. Boilers shall bear an ASME "H" stamp.
- D. Boiler shall be CSA certified.

- E. Boiler shall be AHRI listed and certified.

1.4 COORDINATION

- A. Equipment shall be handled, stored, and installed in accordance with the manufacturer's instructions.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
 - 1. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of two (2) years from date of installation. Pressure vessel of the boiler shall be warranted for a period of ten (10) years from date of installation.

1.6 CERTIFICATIONS

- A. Manufacturer's Certification: The boiler manufacturer shall certify the following:
 - 1. The products and systems furnished are in strict compliance with the specifications.
 - 2. The boiler, burner and other associated mechanical and electrical equipment have all been properly coordinated and integrated to provide a complete and operable boiler.
 - 3. ASME certification.
 - 4. CSA (AGA/CGA) certification.
 - 5. The specified factory tests have been satisfactorily performed.
 - 6. The equipment furnished contains inter-changeable parts with the specified equipment so that all major equipment parts can be obtained from the specified manufacturer.
- B. Contractor's Certification: The contractor shall certify the following:
 - 1. The products and systems installed are in strict compliance with the specifications and all applicable local or state codes.
 - 2. The specified field tests have been satisfactorily performed.
 - 3. The equipment furnished contains inter-changeable parts with the specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design - Furnish and install **LOCHINVAR KNIGHT WHB399**, factory "packaged" low pressure hot water boiler with stainless steel heat exchanger as manufactured by **LOCHINVAR** or an approved equal.
- B. Each factory "packaged" boiler shall be complete with all components, accessories and appurtenances necessary for a complete and operable boiler as specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.
- C. Each factory "packaged" boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all

be assembled and furnished by the boiler manufacturer. The boiler manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory "packaged" boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

2.2 PERFORMANCE CRITERIA

- A. CSA certified efficiency of not less than 92 %.
- B. Each boiler shall be capable of operating with a minimum outlet water temperature of 68° F.
- C. Boiler shall comply with ASME Section IV for 80 psig (max 200° F).
- D. Boiler relief valve setting shall be 80 psig.
- E. Fuel shall be natural gas. Natural gas shall be supplied at a pressure of no less than 4 inch w.c. to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 inch w.c.
- F. Power voltage shall be 120 VAC, 1-phase, 60 hertz. Control voltage shall be 24 VAC (transformer to be supplied by boiler manufacturer).

2.3 BOILER DESIGN

- A. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.
- B. Boiler to be certified for installation with Category IV venting (stack) as defined in NFPA 54 (ANSI Z221), latest edition. Contractor must provide venting (stack) certified for installation on a Category IV appliance.

2.4 BOILER CONNECTIONS

- A. Each boiler shall be provided with all necessary inlet and outlet connections.

2.5 BOILER TRIM

- A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:
 - 1. Safety relief valve shall be provided in compliance with the ASME code. Contractor to pipe to acceptable drain.
 - 2. Water pressure temperature gauge.
 - 3. Primary low water flow fuel cutoff (probe type with manual reset).
 - 4. Manual reset high limit water temperature controller.
 - 5. Operating temperature control to control the sequential operation of the burner.
 - 6. Separate inlet and outlet water temperature sensors capable of monitoring flow.
 - 7. Exhaust temperature sensor.
 - 8. Outdoor temperature sensor.

2.6 BOILER FUEL BURNING SYSTEM

- A. Integral fully automatic fuel burner.

- B. Integral variable speed power blower.
- C. Each boiler shall be equipped for direct spark ignition.
- D. Each boiler shall be provided with a "Full Modulating" firing control system. The control must have the following capabilities:
 - 1. Maintain single set point
 - 2. Reset the set point based on outdoor air temperature.
 - 3. Boiler shutdown based on outdoor air temperature
 - 4. Alarm relay for any for any manual reset alarm function.
 - 5. LED Display.
 - 6. Local Manual Operation.
 - 7. Remote Control System.
 - 8. On board Domestic Hot Water Priority System.
 - 9. Standard LON BUS for complete integration into building management systems.

2.7 MAIN GAS VALVE TRAIN

- A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:
 - 1. One (1) manual shutoff valve.
 - 2. Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.
 - 3. Air – Gas ratio control (maximum inlet pressure 14 in w.c.)
 - 4. One (1) low gas pressure switch (manual reset).
 - 5. One (1) high gas pressure switch (manual reset).
 - 6. Two (2) pressure test ports.

2.8 COMBUSTION AIR CONTROL SYSTEM

- A. Factory assembled integral combustion air control system with:
 - 1. One (1) low airflow differential pressure switch.
 - 2. High exhaust back pressure switch.

2.9 BURNER CONTROL SYSTEM

- A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The 120/1/60 power supply to each boiler shall be protected by a 15 Amp circuit breaker located in the MCC (supplied by contractor).
- B. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

2.10 BOILER CONTROL PANEL

- A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:
 - 1. One (1) burner "on-off" switch.

2. One (1) electronic combination temperature control and system control.
 3. Control circuit breaker.
 4. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.
- B. LED Display Panel to adjust set points and control operating parameters. LED display to indicate burner sequence, all service codes, fan speed, boiler set point, sensor values such as inlet, outlet, flue gas and outdoor air.

2.11 VENTING KITS

- A. Kit: Complete system, CPVC, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.
- B. Combustion-Air Intake: Complete system, CPVC pipe, vent terminal with screen, inlet air coupling, and sealant.

PART 3 - EXECUTION

3.1 GENERAL

- A. The installation shall be provided by the contractor in accordance with the requirements of the codes specified hereinbefore. All of the contractor's work shall be performed in a workmanlike manner, by experienced workmen previously engaged in boiler plant construction and shall be under the supervision of a qualified installation supervisor.

3.2 INSTALLATION

- A. Install equipment in strict compliance with manufacturer's installation instructions.
- B. Install equipment in strict compliance with state and local codes and applicable NFPA standards.
- C. Maintain manufacturer's recommended clearances around sides and over top of equipment.
- D. Install components that were removed from equipment for shipping purposes.
- E. Install components that were furnished loose with equipment for field installation.
- F. Provide all electrical control and power interconnect wiring.
- G. Provide all fuel gas piping see Section 231123 FACILITY NATURAL GAS PIPING.
- H. Provide boiler venting:
 1. Install flue venting kit and combustion-air intake.
 2. Follow manufacturer's instructions.
- I. Provide all piping for boiler pipe connections.
- J. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Boiler will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION 235216

SECTION 236313 - AIR COOLED CONDENSERS

PART ONE GENERAL

1.01 DESCRIPTION - Provide air cooled condensers indicated.

1.02 SUBMITTALS

- A. Product data, including rated capacities of selected model clearly indicated weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.
- B. Shop drawings detailing dimensions, required clearances, methods of assembly of components, and mounting and connection details.
- C. Wiring Diagram, manufacturer's electrical requirements for power supply wiring to units. Submit ladder type wiring diagram for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions that must be field installed.
- D. Maintenance and Operating data.
- E. Quality Control
 - 1. Certification of compliance with specified ARI, UL, and ASHRAE fabrication requirements.
 - 2. Certification of compliance with performance specified.

1.03 QUALITY ASSURANCE

- A. Capacity rating shall be in accordance with ARI Standard 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment."
- B. Refrigeration system shall be constructed in accordance with ASHRAE Standard ASHRAE 15 "Safety Code for Mechanical Refrigeration."
- C. Air Cooled Condensers shall meet minimum COP/Efficiency levels as prescribed in ASHRAE 90A "Energy Conservation in New Building Design."
- D. Air Cooled Condensers shall be listed by UL and have UL label affixed.

PART TWO PRODUCTS

2.01 AIR COOLED CONDENSOR (See Drawings)

- A. General - Factory-assembled and tested, air cooled condensers, consisting of casing, condenser coils, condenser fans and motors, and unit controls. Capacities and electrical characteristics as specified herein. **As a Basis-of-Design, AAON model CFA-011-B, Condensing Unit, scroll compressor.**
- B. General:
 - 1. The 4TTR3 shall be fully charged from the factory for matched indoor section and up to 15 feet of piping. This unit must be designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities shall be matched with a wide selection of air handlers and furnace coils that are AHRI certified. The unit is certified to UL 1995. Exterior must be designed for outdoor application. Casing:
 - a. Zinc Coated, Heavy Gauge, Galvanized Steel.
 - b. Weather Resistant Baked Enamel Finish.

- c. Meets ASTM B117, 672 hr Salt Spray Test.
 - d. Removable Single Side Maintenance Access Panels.
 - e. Lifting Handles in Maintenance Access Panels.
 - f. Unit Base Provisions for Forklift and/or Crane Lifting.
- C. Refrigeration System – Compressor:
1. Single Refrigeration Circuit with Integral Subcooling Circuit.
 2. Single Direct Drive Hermetic Scroll Compressor.
 3. Suction Gas-Cooled Motors w/ +/- 10% Voltage Utilization Range of Unit Nameplate Voltage.
 4. Crankcase Heater.
 5. Internal Temperature and Current Sensitive Motor Overloads.
 6. Factory Installed Liquid Line Filter Driers.
 7. Phase Loss/Reverse Rotation Monitor.
 8. Liquid Line Service Valves (with gauge port).
 9. Suction Line Service Valves (with gauge port).
 10. External High Pressure Cutout Devices.
 11. External Low Pressure Cutout Devices.
 12. Evaporator Defrost Control.
 13. Loss of Charge Protection (Discharge Temperature Limit).
- D. Condenser Coil:
1. 3/8" Internally Enhanced Copper Tube Mechanically Bonded to Lanced Aluminum Plate Fins.
 2. Factory Pressure and Leak Tested to 660 psig.
 3. Perforated Steel Hailguards.
- E. Condenser Fan:
1. 26" or 28" Propeller Fan(s).
 2. Direct Drive.
 3. Statically and Dynamically Balanced.
- F. Condenser Motor(s):
1. Permanently Lubricated Totally Enclosed or Open Construction.
 2. Built-In Current and Thermal Overloads.
 3. Ball or Sleeve Bearing Type.
- G. Controls:
1. Choice of Electro-mechanical or Microprocessor.
 2. Completely Internally Wired.
 3. Numbered and Colored Wires.
 4. Contactor Pressure Lugs or Terminal Block.
 5. Unit External Mounting Location for Disconnect Device.
- H. Hailguards:
1. Condenser Coil Protection from Hail, Vandals, Etc.
 2. Perforated, Painted Galvanized Steel.
 3. Factory or Field Installed.
- I. Controls: Electro-Mechanical:
1. 24V Control Circuit.
 2. Control Transformer.
 3. Thermostat Compatible.
 4. Anti-Short Cycle Timer.
- J. Low Ambient (Fan ON/OFF):

1. Provides Unit Cooling Operation to Outdoor Ambient of 0°F.
2. Liquid Line Temperature Controls Condenser Fan Operation.
3. 1 Kit Per Condenser Fan Required.

K. Vibration Isolators:

1. Neoprene-In-Shear or Spring Flex Choice.
2. Reduce Vibration Transmission to Building Structures, Equipment, and Adjacent Spaces.
3. Reduce Noise Transmission to Building Structures, Equipment, and Adjacent Spaces.

PART THREE EXECUTION

3.01 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all air cooled condensers may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Verify roof structure, mounting supports, and membrane installations are completed to the proper point to allow installation of roof mounted units.
- C. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install air cooled condensers in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Install ground-mounted units on 4" thick reinforced concrete pad, 4" larger on each side than condensing unit. Concrete, formwork, and reinforcing are specified in Division 3. Coordinate installation of anchoring devices.
- C. Install furnished field mounted accessories.

3.03 CONNECTIONS

- A. Refrigerant piping installation requirements are specified in other sections of Division 23. The Drawings indicate the general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow servicing and maintenance.

3.04 FIELD QUALITY CONTROL

- A. Provide the services, to include a written report, of a factory authorized service representative to examine the field assembly of the components, installation, and piping and electrical connections.
- B. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.
- C. Start-Up - Place units into operation and adjust controls and safeties. Replace damaged or malfunctioning components and controls.

END OF SECTION 236313

AIR-COOLED CONDENSORS

236313 - 3

SECTION 237313 - MODULAR INDOOR AIR-HANDLING UNITS**PART ONE GENERAL**

1.01 DESCRIPTION

- A. Provide modular air-handling unit with coils for indoor installation.
- B. Provide control wiring between field-installed controls, indicating devices, and unit control panels.

1.02 SUBMITTALS

- A. Product Data for each type of modular indoor air-handling unit indicated. Include the following:
 - 1. Certified fan-performance curves with system operating conditions indicated.
 - 2. Certified fan-sound power ratings.
 - 3. Certified coil-performance ratings with system, operating conditions indicated.
 - 4. Motor ratings, electrical characteristics, and motor and fan accessories.
 - 5. Material gages and finishes.
 - 6. Filters with performance characteristics.
 - 7. Dampers, including housings, linkages, and operators.
 - 8. Control Board
- B. Shop Drawings, assembly-type, showing unit dimensions, weight loadings, required clearances, construction details, and field connection details. Show dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor's electrical characteristics, gages and finishes of materials, and installation instructions.
- C. Wiring Diagrams – Power, signal, and control wiring.
- D. Coordination Drawings – Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- E. Maintenance Data and Operating Instructions - Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and trouble-shooting guide to remedy malfunctions.
- F. Warranty – Manufacturer's standard written warranty.

1.03 QUALITY ASSURANCE

- A. Source Limitations – Obtain modular indoor air-handling units through one source from a single manufacturer.
- B. Products – Drawings indicate size, profiles, and dimensional requirements of modular indoor air-handling units and are based on the specific system indicated.
- C. Electrical Components, Devices, and Accessories – Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. NFPA Compliance – Modular indoor air-handling units and components shall be designed, fabricated, and installed in compliance NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

- E. ARI Certification – Modular indoor air-handling units and their components shall be factory tested according to ARI 430, “Central-Station Air-Handling Units,” and shall be listed and labeled by ARI.
- F. Work shall comply with National Electrical Code (NFPA 70).

1.04 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 CAST-IN-PLACE CONCRETE.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- C. Coordinate size and location of structural steel support members.

1.05 EXTRA MATERIALS – Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- A. Filters - One set for each modular indoor air-handling unit.
- B. Gaskets – One set for each access door.

PART TWO PRODUCTS

2.01 AIR HANDLING UNIT (See Drawings)

- A. Basis of Design - AAON Model # **V3-CRB** Subject to compliance with requirements, manufacturers offering air handling units which may be incorporated in the work include, but are not limited to, the following:
 - 1. AAON.
 - 2. Carrier Air Conditioning.
 - 3. Trane.
 - 4. York Div.; Borg-Warner Corp.
- B. Description – Indoor air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, condensate pans, mixing dampers, control devices, and accessories.
- C. Cabinet:
 - 1. Materials - Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
 - a. Outside Casing –Galvanized steel, 18 gauge thick.
 - b. Inside Casing –Galvanized steel, 18 gauge thick.
 - 2. Cabinet Insulation – Comply with NFPA 90A or NFPA 90B.
 - a. Materials – ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
 - b. Thickness –1-1/2”.
 - c. Thermal Conductivity (k-value) – 0.26 at 75 deg F. mean temperature.
 - d. Fire-Hazard Classification – Maximum flame-spread index of 25 and smoke-developed in excess of 50, when tested according to ASTM C 411.
 - e. Liner Adhesive – Comply with NFPA 90A or NFPA 90B and ASTM C 916.
 - f. Mechanical Fasteners – Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.

- a. Sound Power Level Ratings – Comply with AMCA 301, “Methods for Calculating Fan Sound Ratings from Laboratory Test Data.” Test fans according to AMCA 300, “Reverberant Room Method for Sound Testing of Fans.” Fans shall bear AMCA-certified sound ratings seal.
- b. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, “Laboratory Methods of Testing Fans for Rating.”

E. Motors:

1. Torque Characteristics – Sufficient to accelerate driven loads satisfactorily.
2. Motor Sizes – Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factory range.
3. Temperature Rating – 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).
4. Service Factor – 1.15 for polyphase motors and 1.35 for single-phase motors.
5. Motor Construction – NEMA MG 1, general purpose, continuous duty, Design B mounted on adjustable base.
6. Bearings:
 - a. Ball or roller bearings with inner and outer shaft seals.
 - b. Grease lubricated.
 - c. Designed to resist thrust loading where belt or other drives produce lateral or axial thrust in motor.
7. Enclosure:
 - a. Open dripproof motors if satisfactorily housed or remotely located during operation.
 - b. Guarded dripproof motors if exposed to contact with employees or building occupants.
8. Overload Protection – Build-in, automatically resetting, thermal-overload protection.
9. Noise Rating – Quiet.
10. Efficiency – Energy-efficient motors shall have a minimum efficiency as scheduled according to IEEE 112, Test Method B. If efficiency is not specified, motors shall have a higher efficiency than “average standard industry motors” according to IEEE 112, Test Method B.
11. Nameplate – Indicate ratings, characteristics, construction, special features, and complete identification of manufacturers.
12. Wiring – Electrical devices and connections are specified in Division 26 Sections.

F. Coils:

1. Coil Sections - Common or individual, insulated, galvanized-steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.
2. Water Coils – Continuous circuit coil fabricated according to ARI 410.
 - a. Fact-and-Bypass Dampers – Vertical coils.
 - b. Piping Connections – Threaded, on same end.
 - c. Tubes – Copper.
 - d. Fins – Aluminum, 12 fins per inch.
 - e. Fin and Tube Joint – Mechanical bond or Silver brazed.
 - f. Headers –Cast iron with cleaning plugs and drain and air vent tappings.
 - g. Frames – Galvanized-steel channel frame.
 - h. Ratings – Design tested and rated according to ASHRAE 33 and ARI 410.
 - (i) Working-Pressure Ratings – 200 psig, 325 deg F.
 - i. Source Quality Control – Test to 300 psig and to 200 psig underwater.
3. Refrigerant Coils – Coil designed for use with R-410a refrigerant, fabricated according to ARI 410.
 - a. Capacity Reduction – Circuit for control.
 - b. Tubes – Copper.
 - c. Fins – Aluminum with fin spacing 12 per inch.
 - d. Suction and Distributor – Seamless copper tube with brazed joints.
 - e. Frames – Galvanized-steel channel frame, 16 gauge minimum

- f. Ratings – Design tested and rated according to ASHRAE 33 and ARI 410.
- g. Working-Pressure Ratings – 100 psig, 400 deg F.
- h. Source Quality Control – Test to 300 psig and to 200 psig underwater.

G. Dampers

1. General – Leakage rate, according to AMCA 500, laboratory Methods for Testing Dampers for Rating,” shall not exceed 2% of air quantity at 2000-fpm face velocity through damper and 4” wg pressure differential.
2. Damper Operators – Electric specified in Section “HVAC Instrumentation and Controls.”
3. Low-Leakage, Outside-Air Dampers – Double-skin, airfoil-blade galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, in parallel-blade arrangement with steel operating rods rotating in sintered bronze bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/SF at 1” wg And 9 cfm/SF at 4” wg.
4. Face-and-Bypass Dampers – Opposed-blade galvanized-steel dampers with steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame and with operating rods connected with a common linkage. Break-form damper blades, provide gaskets and edge seals, and mechanically fasten to operating rod.
5. Zone Dampers – Two single-blade galvanized-steel dampers offset 90 degrees from each other on steel operating rod rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame. Break-form damper blades, provide gaskets and edge seals, and mechanically fasten to operating rod.
6. Combination Filter and Mixing Box – Parallel-blade galvanized-steel dampers mechanically fastened to steel operating rod in reinforced, galvanized-steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously. Cabinet support members shall hold 2” thick, pleated, flat permanent or throwaway filters. Provide hinged access panels or doors to allow removal of filters from both sides of unit.
7. Controls-Units to come with factory open LON controller

H. Filter Section:

1. Filters – Comply with NFPA 90A.
2. Filter Section – Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side.
3. Disposable Panel Filters – Factory-fabricated, viscous-coated, flat-panel, disposable air filters with holding frames.
 - a. Media – Interlaced glass fibers sprayed with nonflammable adhesive.
 - b. Frame – Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.
 - c. Duct-Mounting Frames – Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.
4. Extended-Surface, Disposable Panel Filters – Factory-fabricated, dry, extended-surface filters with holding frames.
 - a. Media – Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
 - (i) Media and Media Grid Frame – Nonflammable cardboard.
 - b. Duct-Mounting Frames – Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.
5. Extended-Surface, Nonsupported-Media Filters – Factory-fabricated, dry, extended-surface, self-supporting filters with holding frames.
 - a. Media – Fibrous material constructed so individual pleats are maintained in tapered form by flexible internal supports under rated-airflow conditions.
 - b. Filter-Media Frame –Galvanized steel.
6. Duct-Mounting Frames – Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

- I. Discharge Plenum Section:
 - 1. Plenums shall be provided to efficiently turn air and provide sound attenuation. Discharge plenum opening types and sizes shall be scaled to meet engineering requirements. The vertical discharge plenum height may be scaled to accommodate the appropriate discharge duct height.
- J. Airflow Switch
 - 1. Differential pressure switch piped to the discharge and suction sides of the fan shall indicate fan status.
- K. Electrical Power connection
 - 1. Provide unit mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection for single connection of power to unit.
 - 2. Provide a duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

2.02 VFD Drive (See Drawings):

- A. Basis of Design - Danfoss Model Micro Drive Subject to compliance with requirements, manufacturers offering VFD Drives which may be incorporated in the work include, but are not limited to, the following:
 - 1. Square D.
 - 2. ABB Drives.

PART THREE EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Lifting Instructions
 - 1. The air handling units must be rigged, lifted, and installed in strict accordance with the manufacturer's recommendations.
 - 2. Indoor units shall be shipped on an integral base frame for the purpose of mounting units to a housekeeping pad and providing additional height to properly trap condensate from the unit. The integral base frame may be used for ceiling suspension, external isolation, or as a housekeeping pad.
 - 3. All units will be shipped with an integral base frame designed with the necessary number of lift points for safe installation.
 - 4. All lifting lugs are to be utilized during lift. The lift points will be designed to accept standard rigging devices and be removable after installation. Units shipped in sections will have a minimum of four points of lift.
- B. Per ASHRAE 62.1 recommendation, indoor air handling units will be shipped stretch-wrapped to protect unit from in-transit rain and debris.

- C. Concrete Bases – Install floor mounting units on 4” high concrete bases. See Section 033000 “Cast In Place Concrete” for concrete base materials and fabrication requirements.
- D. Install modular indoor air-handling units with the following vibration-control devices.
 - 1. Units with Internally Isolated Fans – Secure units to anchor bolts installed in concrete bases.
 - 2. Floor-Mounted Units – Support on concrete bases using neoprene pads. Secure units to anchor bolts installed in concrete bases.
 - 3. Floor-Mounted Units – Support on concrete bases using housed-spring isolators. Secure units to anchor bolts installed in concrete bases.
 - 4. Suspended Units – Suspend units from structural-steel support frame using threaded steel rods and spring hangers.
- E. Arrange installation of units to provide access space around modular indoor air-handling units for service and maintenance.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division-23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Provide piping, valves, accessories, gages, supports, and flexible connectors as indicated.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to modular indoor air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using NPS 1¼, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and installed cleanouts at changes in direction.
- E. Hot-Water Piping – Comply with applicable requirements in Section 232113 “Hydronic Piping”. Connect to supply and return coil tapings with shutoff or balancing valve and union flange at each connection.
- F. Duct installation and connections requirements are specified in other Section 233113 “Metal Ducts”. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections. Provide ductwork, accessories, and flexible connections indicated.
- G. Electrical Wiring - Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 Sections for power wiring, switches, and motor controls. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- H. Ground equipment according to Section 260526 “Grounding and Bonding for Electrical Systems”.
- I. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer’s Field Service – Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test – After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.

2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
3. Fan Operational Test – After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.05 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Final Checks before Startup. Perform the following:
 1. Verify shipping, blocking, and bracing are removed.
 2. Verify unit is secure on mountings and supporting devices and connections to piping, ducts, and electrical systems are complete. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Perform cleaning and adjusting specified in this Section.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 6. Set zone dampers to fully open position for each zone.
 7. Set face-and-bypass dampers to full face flow.
 8. Set outside- and return-air mixing dampers to minimum outside-air setting.
 9. Comb coil fins for parallel orientation.
 10. Install clean filters.
 11. Verify manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- C. Starting Procedures for modular indoor air-handling units include the following:
 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
 2. Measure and record motor electrical values for voltage and amperage.
 3. Manually operate dampers from fully closed to fully open position and record fan performance.
- D. Refer to Section 230593 “Testing, Balancing, and Adjusting for HVAC” for modular indoor air-handling system testing, adjusting, and balancing.
- E. ADJUSTING – Adjust damper linkages for proper damper operation.

3.06 CLEANING

- A. Clean modular indoor air-handling units internally, on completion of installation, according to manufacturer’s written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing modular indoor air-handling and air-distribution systems, clean filter housings and install new filters.

3.07 DEMONSTRATION – Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain modular indoor air-handling units.

END OF SECTION 237313

SECTION 238239.13 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cabinet unit heaters with centrifugal fans and steam coils.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Indicate location and arrangement of piping valves and specialties.
 - 3. Indicate location and arrangement of integral controls.
 - 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. Basis-of-Design - Furnish and install **MODINE Cabinet Unit Heater, See Drawing sheet M4.0 for model number**, factory "packaged" steam cabinet unit heater as manufactured by **MODINE** or an approved equal.
- B. Factory-assembled and -tested unit complying with AHRI 440.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.

- B. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- C. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," Section 232116 "Hydronic Piping Specialties," Section 232213 "Steam and Condensate Heating Piping," and Section 232216 "Steam and Condensate Heating Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Comply with safety requirements in UL 1995.
- D. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of cabinet unit heater. Steam specialties are specified in Section 232216 "Steam and Condensate Heating Piping Specialties."
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust initial temperature set points.

END OF SECTION 238239.13

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART ONE GENERAL

1.01 SUMMARY

- A. Section includes common electrical plumbing material and work.

1.02 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Provide electrical materials that are listed and labeled for the purpose intended.

PART TWO PRODUCTS

PART THREE EXECUTION

3.01 SITE SPECIFIC ELECTRICAL INSTALLATION REQUIREMENTS

- A. **All generator and switchboard work requiring shutdowns need to be completed on non-drill weekends. During shutdowns contractor must supply standby generators to keep medical refrigerators circuits energized.**

3.02 GENERAL ELECTRICAL EQUIPMENT INSTALLATION REQUIREMENTS

- A. Install electrical equipment to allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
- B. Install electrical equipment to provide for ease of disconnecting the equipment with minimum interference to other installations.
- C. Install electrical equipment to allow right of way for piping and conduit installed at required slope.
- D. Install electrical equipment to ensure that connecting raceways, cables, wireways, cable trays, and busways are clear of obstructions and of the working and access space of other equipment.
- E. Install required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- F. Install sleeve and sleeve seals of type and number required for sealing electrical service penetrations of exterior walls and/or footings.
- G. Comply with NECA 1.

3.03 CUTTING AND PATCHING

- A. Cutting and patching of electrical equipment, components, and materials shall include removal and legal disposal of indicated materials, components, and equipment.

- B. Cut out and remove designated items and/or components made obsolete or out-of-use by the new work, as indicated.
- C. Locate, identify, and protect electrical services and components passing through demolition or remodeling areas and to remain active and operational. When such services must be interrupted, provide temporary services for affected areas and notify the Owner prior to changeover.
- D. Cutting and patching of electrical equipment, components, and materials to remain and be utilized shall be done by an electrician or electrician supervised personnel.
- E. Patch existing finished surfaces and components using new materials matching existing materials and using experienced installers. Installer's qualifications refer to the materials and methods required for the surface and components being patched.
- F. Also see Section 01900 EXECUTION REQUIREMENTS.

3.04 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications of other divisions included as a part of this specification for rough-in requirements.
- C. Provide for chases, slots, and openings in building components to allow for electrical installation.
- D. Coordinate cutting and patching of building components to accommodate installation of equipment and materials.
- E. Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide maximum available headroom.
- F. Install electrical equipment to facilitate maintenance and repair or replacement of components. As much as practical, connect equipment for ease of disconnecting with a minimum of interference with other equipment.

3.05 TESTS AND ADJUSTMENTS - Electrical circuits shall be tested as soon as conductors are installed, and final tests shall be made in presence of DMVA representative. If circuits are not properly controlled and insulated, make necessary changes and repairs. Electric motors shall be checked for proper rotation.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART ONE GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.02 SUBMITTALS

- A. Product Data: For the following:
 - 1. Conductors and cables.
- B. Field quality-control reports.

PART TWO PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2 Type THHN-2-THWN-2 Type XHHW-2 and Type SO.
- C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for Type SO and Type USE with ground wire.
- D. The following cable **shall not be used** on this project: armored cable Type AC, metal-clad cable Type MC, mineral insulated Type MI, and nonmetallic-sheathed cable Type NM.
- E. Furnish wire on spools.

2.02 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART THREE EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders and Branch Circuits: Copper. Solid for No. 16 AWG and smaller; stranded for No. 14 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway.
- B. Feeders and Branch Circuits, exposed and concealed: Type THHN-2-THWN-2, single conductors in raceway.
- C. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS.
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**PART ONE - GENERAL**

1.01 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.02 SUBMITTALS

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

1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART TWO - PRODUCTS

2.01 CONDUCTORS

- A. Insulated Conductors – Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors - ASTM B-3.
 - 2. Stranded Conductors - ASTM B-8.
 - 3. Tinned Conductors - ASTM B-33.
 - 4. Bonding Cable – 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4" in diameter.
 - 5. Bonding Conductor – No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper – copper tape, braided conductors, terminated with copper ferrules; 1 5/8" wide and 1/16" thick.
 - 7. Tinned Bonding Jumper – Tinned-copper tape, braided conductors, terminated with copper ferrules; 1 5/8" wide and 1/16" thick.
- C. Bare Grounding Conductor:
 - 1. No. 4 AWG minimum, soft-drawn copper.
- D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 2 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.02 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for conductors and Pipes – Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors – Clamp type, sized for pipe.

- C. Bus-bar Connectors: Welded Connectors – Exothermic-welding kits of types recommended by kit manufacturer for materials being joined for connection to ground bus bar.

2.03 GROUNDING ELECTRODES

- A. Ground Rods - Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core; 3/4"D. x 10' length each, connected with manufacturers connector.

PART THREE - EXECUTION

3.01 APPLICATION

- A. Conductors – Install solid conductor for No. 16 AWG and smaller, and stranded conductors for No. 14 AWG and larger, unless otherwise indicated.
- B. Isolated Grounding Conductors – Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground connections – Welded connectors.
 - 3. Connections to Structural Steel – Welded connectors.
 - 4. Connections to new generator frame – Welded connectors.
 - 5. Connections to existing building counterpoise – Welded connectors.

3.02 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits. Ground the neutral of the new engine generator's alternator to the building's electrical grounding system.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. New panelboard grounding bars.
 - 3. Receptacle circuits.
 - 4. New fuel tank grounding system.
 - 5. New day tank grounding system.
 - 6. New fuel polishing system control panel.
 - 7. Flexible raceway runs.

3.04 INSTALLATION

- A. Install insulated grounding conductors with all underground conductors.
- B. Grounding Conductors – Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- C. Ground Rods – Drive rods until tops are 6" below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with bare conductors buried at least 24" below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds.
- D. Bonding Straps and Jumpers – Install in locations accessible for inspection and maintenance, except where routed throughout short lengths of conduit.
 - 1. Bonding to Structure – Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports – Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Bond each aboveground portion of diesel fuel piping system.

3.05 CONNECTIONS

- A. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connections methods such that metals in direct contact with each other will be galvanic compatible.
 - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
 - 2. Make connections with clean bare metal at points of contact.
 - 3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
 - 4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
- B. Exothermic Welded Connections - Use for connections to structural steel. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.
- E. Compression Connections - Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
- F. Moisture Protection - Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.06 LABELING

- A. Comply with requirements in Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS for instruction signs. The label or its text shall be green.
 - 1. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 - 2. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.07 FIELD QUALITY CONTROL

- A. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements. Perform the following tests and inspections and prepare test reports:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test completed grounding system at each location where a maximum ground resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by the 2-point method in accordance to IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and less - 10 ohms.
 - 2. Power and Power Generating Equipment rated 500kVA to 1000 KVA - 5 ohms.
 - 3. Power and Lighting Equipment rated over 1000 KVA - 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment – 3 ohms.
 - 5. Pad-Mounted Equipment - 5 ohms.
- C. Excessive Ground Resistance - If ground resistance to ground exceeds specified values, notify DMVA promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART ONE GENERAL

1.01 SUMMARY

- A. Section includes:
1. Hangers and supports for electrical equipment and systems.

1.02 SUBMITTALS

- A. Product Data: For steel slotted support systems, threaded rod, beam clamps, hollow wall anchors, drywall anchors, conduit clamps, and drop-in concrete anchors.

1.03 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART TWO PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway Supports: As described in NECA 1 and NECA 101.
- C. Conduit Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable tray to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: **Shall not be used on this Project.**
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 METAL FABRICATIONS for steel shapes and plates.

PART THREE EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway and Cable Tray: Space supports for EMT and GRC as required by NFPA 70. Minimum rod size shall be 3/8 inch in diameter.
- C. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and to these supports with single-bolt conduit clamps.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet anchorage requirements.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 METAL FABRICATIONS for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**PART ONE GENERAL**

1.01 SUMMARY

- A. Section Includes:
1. Metal conduits, tubing, and fittings.
 2. Nonmetal conduits, tubing, and fittings.
 3. Metal wireways and auxiliary gutters.
 4. Surface raceways.
 5. Boxes, enclosures, and cabinets.
 6. Handholes and boxes for exterior underground cabling.

1.02 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
B. EMT: Electrical metallic tubing.
C. RNC: Rigid nonmetallic conduit.
D. LFMC: Liquid-tight flexible metal conduit.

1.03 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART TWO PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. EMT: Comply with ANSI C80.3 and UL 797.
- D. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- E. FMC: Zinc-coated steel flexible metal conduit.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 2. Expansion Fittings: steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- G. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS, TUBING AND FITTINGS

- A. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- B. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Hinged type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

2.04 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- J. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch.
 - 4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART THREE EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Boxes and enclosures, Aboveground: NEMA 250, Type 3R.
 4. Underground: Type EPC-40-PVC NMC, direct buried.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Vehicle Maintenance or parking garage areas from floor to a line 12'-0" AFF. EMT may be used above 12'-1" AFF.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): Use LFMC.
 6. Damp or Wet Locations: GRC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.
- C. **Minimum Raceway Size: 3/4-inch trade size.**
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. EMT: Use set-screw or compression fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.02 BOX APPLICATION

- A. Outlet, Junction and Device boxes shall be Cast-metal, type FD with gasketed cover shall be installed outdoors for receptacle use.

3.03 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.
- D. Complete raceway installation before starting conductor installation.

- E. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. **When conduits are routed underground, or under a concrete slab or floor, arrange stub-ups so curved portions of bends are not visible above finished slab or floor. Change from EPC-40-PVC RNC to GRC before rising above the concrete slab or floor.**
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Install conduits parallel or perpendicular to building lines.
- I. Support conduit within 12 inches of enclosures to which attached.
- J. Above Suspended Ceilings:
 - 1. New walls, utilize EMT or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to provide a grounding path. Install a grounding wire in all raceways and connect to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. Install raceway sealing fittings according to NFPA 70.
- S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. When entering building from outdoors.
 - 2. Where otherwise required by NFPA 70.

- T. Expansion-Joint Fittings:
1. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 2. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
- U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
 3. Refer to paragraph DD below for lighting fixture installations.
- V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Coordinate mounting heights with the architectural plans.
- W. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- X. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Y. **Fixture Whips: Fixture whips not exceeding 72" in length are allowed. Fixture whips shall be FMC raceway and shall connect on lighting fixture to a local junction box. Fixture-to-fixture connections are not allowed. Raceways between junction boxes above the suspended ceiling shall be properly supported EMT.**

3.04 INSTALLATION OF UNDERGROUND CONDUIT

- A. Install underground raceway at 24" below grade. Refer to 3.03, F above for further information.

3.05 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.06 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART ONE - GENERAL

1.01 DESCRIPTION

- A. This Section includes the following:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.02 SUBMITTALS

1.03 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.04 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART TWO - PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.04 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.05 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.06 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners. Utilize stainless steel screws for installing engraved signage.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.07 EQUIPMENT IDENTIFICATION LABELS

- A. Nameplate Data - Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data. Locate nameplate in an accessible location.
- B. Engraved, Laminated Acrylic or Melamine Label: With white letters on a dark-gray background. Minimum letter height shall be 3/8 inch. Size of equipment identification label shall not exceed the enclosures front door or proper lip are where the label is to be fastened.

2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART THREE - EXECUTION

3.01 APPLICATION

- A. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape and marker tape. Identify each ungrounded conductor according to source and circuit number.
- B. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label 4 inches high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2. New equipment under this contract to be labeled:
 - a. Panelboards, electrical cabinets, and enclosures. Install typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be laminated acrylic or melamine label held on with screw fasteners.
 - b. Exterior mounted panelboards.
 - c. Automatic transfer switches.
 - d. Disconnect switches.
 - e. Enclosed circuit breakers.
 - f. Control panels.
 - g. Motor and/or pump starters.
 - h. Push-button stations.
 - i. Contactors.
 - j. Remote-controlled switches and control devices.
 - k. Main circuit breakers and transfer switches.

3.02 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.03 IDENTIFICATION SCHEDULE

- A. Accessible Raceways for Service, Feeder, and Branch Circuits. Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - a. Colors for 208/120-V Circuits:
 - (i) Phase A: Black.
 - (ii) Phase B: Red.
 - (iii) Phase C: Blue.
 - b. Colors for 480/277-V, 3-phase Circuits:
 - (i) Phase A: Brown.
 - (ii) Phase B: Orange.
 - (iii) Phase C: Yellow.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

SECTION 260573 – ELECTRICAL DISTRIBUTION SYSTEM STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260553 “Identification for Electrical Systems”.

1.2 SUMMARY

- A. Section includes investigation of existing panelboards, power panels, switchboards, and feeders connecting these electrical devices, to determine the correct building electrical distribution system. Presently the armories correct electrical distribution system is not reflected in the Existing One-Line Diagram, sheet E9, which carries over to the Proposed One-Line Diagram, sheet E10. Project summary tasks for this study include but are not limited to:
 - 1. Project electricians to familiarize themselves with the existing electrical distribution layout.
 - 2. Verify the location of all existing panelboards, power panels, feeder junction enclosures, and switchboards within the armory and all armory out-buildings (example: Generator shed). Make note on a drawing indicating actual location of devices named above.
 - 3. Utilizing the Existing One-Line diagram, verify existing panelboards, power panels, and switchboard Identification (names) and locations. Coordinate with the DMVA electrical engineer for additional prints of past projects including original building construction drawings (to be transferred to contractor in computer PDF file form) if these items will help in fulfilling this task.
 - 4. The study is to:
 - a. Find the existing panelboards, power panels, feeder junction enclosures, and switchboard locations.
 - b. Determine the amperage size of the existing panelboards, power panels, switchboard bussing.
 - c. Determine where each existing panelboard, power panel, feeder junction enclosures, and switchboard is fed from.
 - d. Determine the size of each existing panelboard, power panel, and switchboard’s feeder which includes conductor AWG size, conductor count, and enclosing raceway size (internal diameter in inches). This also includes the feeder’s grounding conductor if applicable.
 - e. Determine the amperage size, circuit breaker setting (if circuit breaker is adjustable), and SCCR for each existing overcurrent protective device for feeders serving the panelboards and power panels within the distribution system **and** their identification tag on the overcurrent protective device (what the device is feeding). Many identification tags are mislabeled or missing at this time.
 - f. Feeder junction enclosures: As shown on the Existing One-Line Diagram, sheet E9, there are junction enclosures with a single feeder from the “up-stream” panelboard or power panel, that junction off to many panelboards and doesn’t have overcurrent protection devices within the junction enclosure. Determine the location of these feeder junction enclosures.

ELECTRICAL DISTRIBUTION SYSTEM STUDY

- g. Once the DMVA Engineer agrees to the extent of the findings the contractor shall relabel miss-labeled switchgear, distribution panels, and panelboards.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- E. SCCR: Short-circuit current rating.
- F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- G. Single-Line Diagram: See "One-Line Diagram."

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
 - 1. The following are from the Coordination Study Report:
 - a. Final one-line diagram reflecting changes to the Existing One-Line Diagram as well as the Proposed One-Line Diagram (a new One-Line Diagram which includes changes to electrical distribution system due to this contract section). Diagrams should show feeder information as follows: number and size of feeder conductors, size of feeder raceway.
 - b. List of all corrections found and made to the One-Line Diagrams in 1a above.
 - c. List of all junction boxes found and their locations where a single feeder enters a junction box and splits off feeding more than one panelboard.
 - d. List of all feeder fuse or circuit breaker sizes and settings (if applicable).

PART 2 - PRODUCTS

- 2.1 Provide and install new identification signs or tags on circuit breakers feeding panelboards and switchgear that are found to be miss-labeled. Follow specification section 260533 "Identification for Electrical Systems" for proper identification products.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the armories electrical distribution system. Coordinate with the facility maintenance mechanic for access into locked rooms.
1. Utilize the proper personal protection equipment and apparel when opening panelboards, switchboards, or other electrical equipment.
 2. Carry out the tasks as specified in the Part 1 Summary listing.
 3. Send the DMVA Engineer a preliminary report and drawing set toward the end of the installation project. A review of these items will result in questions and comments from the engineer that will need to be incorporated in the final report and drawing set.

3.2 SYSTEM STUDY

- A. Extent of electrical power system to be studied is indicated on Sheet E10, "Proposed One-Line Drawing".
- B. Begin analysis at the service, extending down to system overcurrent protective devices and ending at individual panelboards.
- C. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations.

END OF SECTION 260573

ELECTRICAL DISTRIBUTION SYSTEM STUDY

SECTION 260923 - LIGHTING CONTROL DEVICES

PART ONE GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Indoor occupancy timers & sensors.
 2. Site Lighting Control relay.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Operation and maintenance data

PART TWO PRODUCTS

2.01 INDOOR OCCUPANCY SENSORS

- A. General Occupancy Sensor requirements: Coordinate with the Lighting Control & Occupancy Sensor Schedule on the Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Current/Hubbell Control Solutions.
 3. Leviton Manufacturing Co., Inc.
 4. Sensor Switch; Acuity Brands Lighting, Inc.
 5. Watt Stopper.
- C. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- D. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
- E. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- F. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 4. Dual technology sensors shall have an

2.02 SWITCHBOX-MOUNTED DIGITAL TIMER SWITCH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper Industries, Inc.
 2. Hubbell Control Solutions.
 3. Leviton Manufacturing Co., Inc.
 4. Sensor Switch; Acuity Brands Lighting, Inc.
 5. Watt Stopper.
- B. General Requirements for Sensors: Manual-on wall timer switch, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, and marked for intended location and application.
 2. Switch shall be ASHRAE 90.1 Compliant.
 3. Digital readout indicating time left in cycle. Automatically turns load off after preset time.
 4. Programmable: Time-off settings adjustable from 5 minutes to 12 hours.
 5. Switch Rating: Not less than 800-VA fluorescent at 120 V and 800-W incandescent.

2.03 SITE LIGHTING CONTROL MATERIALS

- A. General Requirements for the materials required for the building mounted lighting fixtures are indicated on a detail shown on the DRAWINGS and as follows:
1. Relay: Fuctional Devices, Inc. (Ph: (800) 888-5538, www.functionaldevices.com) model RIB24P30 with the following specifications:
 - a. Control Input: 5-25 Vac/dc, 50-60 Hz.
 - b. Contact Type: one (1) DPDT continuous duty coil.
 - c. Operating Temperature: -30 to 140° F.
 - d. Operate Time: 18ms.
 - e. Relay Status: LED On = Activated.
 - f. Wires: 16", 600 V rated.
 - g. Contact Rating: 20 Amp Resistive @ 300 Vac., 20 Amp Resistive @ 28 Vac., 1 Hp @ 120 Vac.
- B. Shop Drawings: Submittals on the above relay shall be compiled and submitted for review and approval before installation on the project.

PART THREE EXECUTION

3.01 INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
- C. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.
- D. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

3.02 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART ONE - GENERAL

1.01 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
- C. Operation and maintenance data as part of the close-out documentation.
- D. Panelboard schedules for installation in panelboards are to be inserted in the panelboard door as part of the close-out documentation.

1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

PART TWO – PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush or Surface mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 5. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

- C. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression type.
 - 3. Ground Lugs and Bus Configured Terminators: Compression type.
- D. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by:
 - 1. Siemens Power Distribution USA.
 - 2. Square D/Schneider Electric.
 - 3. Eaton Corporation.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated on the Proposed One-Line Diagram. The main circuit breaker **shall not** take up branch circuit breaker spaces. In other words, if the panel is specified as a 42-space panel, the main circuit breaker shall not take up any of those branch circuit spaces but shall be an individual circuit breaker located above or below the branch circuit breakers leaving 42 spaces for installation of 42 single pole circuit breakers.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Provide panel trim unit with the door within door. Trim shall have piano hinge down one side and secured with screws. The inner door shall have concealed hinges; secured with flush latch with tumbler lock; keyed alike.

PART THREE - EXECUTION

3.01 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

G. Comply with NECA 1.

3.02 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS.
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS.
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART ONE - GENERAL

1.01 DESCRIPTION

- A. Provide wiring devices indicated:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Snap switches and associated device plates.
 - 3. Emergency-Stop pushbutton stations.
 - 4. Surface mounted raceway with 120vac receptacle systems.
 - 5. Cord and plug sets,

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART TWO - PRODUCTS

2.01 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration **5-20R**, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 5351 (single), CR5362 (duplex).
 - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration **5-20R**, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell; CR 5253IG.
 - b. Leviton; 5362-IG.
 - c. Pass & Seymour; IG6300.

2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.02 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; VGF20.
 - b. Hubbell; GFR5352L.
 - c. Pass & Seymour; 2095.
 - d. Leviton; 7590.

2.03 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.04 SNAP SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.05 PUSHBUTTON STATIONS

- A. Provide the following non-illuminated Emergency Off Mushroom Head Push Button station based on "Safety Technology International" model SS2221ES-EN. www.sti-usa.com
 1. Push for OFF maintained position – twist to reset.
 2. Red 40mm diameter mushroom head with "Push Emergency Stop" printed on face.
 3. Customized text to read "EMERGENCY BOILER OFF".
 4. Clear plastic button guard, pushbutton enclosure yellow in color.

2.06 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Color shall be manufacturer's standard Ivory color.

WIRING DEVICES

1. Legrand/Wiremold 2400 series surface mounted raceway or equal. Provide Wiremold 2427 series receptacles in locations shown. Once the horizontal run is finished, route the homecoming surface raceway in a corner of the room and up to a point above the suspended ceiling, transition to EMT via a conversion fitting, then home to the panel indicated.
2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with surface metal raceway as required for complete system.

2.07 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel
 3. Material for Unfinished Spaces: Galvanized steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant while in use die-cast aluminum with lockable cover.

2.08 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 1. Wiring Devices Connected to Normal Power System: **BROWN**, unless otherwise indicated or required by NFPA 70 or device listing.

PART THREE - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

3.02 IDENTIFICATION

A. Comply with Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 26726

SECTION 262813 - FUSES**PART ONE - GENERAL**

1.01 SUMMARY

- A. Section Includes: Cartridge fuses rated 600-V ac and less for use in control circuits enclosed switches enclosed controllers.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.

PART TWO - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART THREE - EXECUTION

3.01 FUSE APPLICATIONS

- A. Branch Circuits: Class RK1, time delay.
- B. Control Circuits: Class CC, time delay.

3.02 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.03 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.
- B. All electrical switches shall have the installed fuse size included on the switch label.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES**PART ONE - GENERAL**

1.01 SUMMARY

- A. Section Includes:
1. Fusible switches.
 2. Enclosures.

1.02 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.

1.03 SUBMITTALS

- A. Product Data: For each type of enclosed switch, and component indicated.
- B. Shop Drawings: For enclosed switches. Include plans, elevations, sections, details, and attachments to other work.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Operation and maintenance data.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART TWO - PRODUCTS

2.01 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements provide products by:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty Single Throw, 250-VAC, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Lugs: Suitable for number, size, and conductor material.

2.02 ENCLOSURES

ENCLOSED SWITCHES**262816 - 1**

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- A. Enclosed Switches: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART THREE - EXECUTION

3.01 INSTALLATION

- A. Install individual wall-mounted switches with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.02 IDENTIFICATION

- A. Comply with requirements in Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
- C. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Acceptance Testing Preparation:
 - 2. Test insulation resistance for each enclosed switch, component, connecting supply, feeder, and control circuit.
 - 3. Test continuity of each circuit.
 - 4. Tests and Inspections:
 - 5. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Enclosed switches will be considered defective if they do not pass tests and inspections.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual motor starters.

1.2 DEFINITIONS

- A. MCP: Motor circuit protector.
- B. N.C.: Normally closed.
- C. N.O.: Normally open.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE MANUAL MOTOR STARTERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on. Switches shall have fractional or full horsepower rated capability as required by the connected load.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. Square D; a brand of Schneider Electric.
 - 2. Configuration: Non-reversing.
 - 3. Overload relays.

4. Integral padlock capability to lock toggle switch in "OFF" position.
5. Red Pilot light when "ON".
6. Integral control power transformer.
7. Surface mounting.

PART 3 - EXECUTION

2.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall.

2.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved nameplate.

2.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 1. Test continuity of each circuit.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Enclosed controllers will be considered defective if they do not pass tests and inspections.

END OF SECTION 262913

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged engine-generator sets for standby power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Performance requirements for sensitive loads.
 - 5. Day-Tank Fuel system.
 - 6. Remote alarm annunciator.
- B. Related Requirements & Information:
 - 1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.
 - 2. This unit will be installed in an existing block generator building. Removal of the existing 120kW engine/generator is part of this contract.

1.2 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. EPS: Emergency power supply.
- C. EPSS: Emergency power supply system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Include thermal damage curve for generator.
 - 3. Include time-current characteristic curves for generator protective device.
 - 4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
 - 5. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature calculated at max high temp 104 deg F.
 - 6. Include generator characteristics, including, but not limited to 800kw rating, efficiency, reactances, and short-circuit current capability.
- B. Shop Drawings:
 - 1. Include plans and elevations for engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Identify fluid drain ports and clearance requirements for proper fluid drain.

4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights. Also, provide documentation with engineer's signature and seal indicating compliance in meeting IBC seismic code requirements adopted by the State of Michigan for the design and manufacturer of the vibration isolation bases.
5. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Qualification Data: For testing agency.
- C. Source quality-control reports, including, but not limited to the following:
 1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 5. Report of sound generation.
 6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- D. Field quality-control reports.
- E. Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to generator location.
 - c. Training plan.
 - d. EPA compliance document for exhaust emissions.
 - e. Document stating actual exhaust emissions at 100% full load.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: One for every 10 of each type and rating but no fewer than one of each.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved by manufacturer.
- B. The engine generator supplier shall maintain 24 hour parts and service capability within 100 miles of the project site. The distributor shall stock parts as needed to support the generator set package for this specific project. The distributor shall carry sufficient inventory to cover no less than 80% of the parts service within 24 hours and 95% within 48 hours

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two (2) years from date of Substantial Completion for Parts, Travel, and Labor, with No deductibles.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: Caterpillar model C9 PGABR, 300 kW, 375 kVA, diesel fueled unit.
 - 1. Subject to compliance with requirements, contractor may provide a comparable product by another manufacture.
- B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. ASME Compliance: Comply with ASME B15.1.
- B. NFPA Compliance:
 - 1. Comply with NFPA 37.
 - 2. Comply with NFPA 70.
 - 3. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with current EPA Standards and applicable state and local government requirements for Emergency Standby Rating at time of delivery.
- E. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: -29 to 40 deg C [-20 to +104 deg F].
 - 2. Relative Humidity: Zero to 95 percent.
 - 3. Altitude: Sea level to 850 feet.

2.3 ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. EPSS Class: Engine-generator set shall be classified in accordance with NFPA 110.
- D. Governor: Adjustable isochronous, with speed sensing.
- E. Emissions: Comply with current EPA Standards for Emergency Standby Rating at time of delivery.
- F. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- G. Capacities and Characteristics:
 - 1. Power Output Ratings: Continuous electrical output power rating for standby operation of not less than 300kW, at 0.8 power factor, 208Y/120-volt, three phase, 4-wire, 60 hertz, with capacity as required to operate as a unit as evidenced by records of prototype testing.
 - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- H. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
 - 6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 - 7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds without damage to generator system components. For a single phase bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
 - 8. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

- a. Provide permanent magnet excitation for power source to voltage regulator.
9. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator.
10. Noise Output: Engine generator shall be tested by the manufacturer per ANSI S12.34. Data documenting performance shall be provided with submittal documentation.

2.4 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- A. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
 1. Designed for operation on a single 208-volt AC, 2500-watt, single phase power connection. Heater voltage shall be shown on the project drawings.
 2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
 3. Provided with a 24VDC thermostat, installed at the engine thermostat housing

Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump. Radiator rating shall be 50 deg C (122 deg F).

4. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
5. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
6. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
8. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C).
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

- B. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- C. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
- D. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- E. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Lead acid with capacity within ambient temperature range specified in "Performance Requirements" Article.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Provide a thermostatically controlled encapsulated heater, one for each battery. The heater(s) shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
 7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
 8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating. The alternator shall have a thermostatically controlled encapsulated heater. The alternator heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article.
 9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 4 deg F (minus 20 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.

- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1 enclosure wall mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 30.
- B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 335213 "Fuel Distribution and Storage." Cast iron, aluminum, copper, and galvanizing shall not be used in the fuel-oil system.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- D. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Fuel-Oil Storage Tank: Comply with requirements in Section 335213 "Fuel Distribution and Storage." Not part of the Engine Generator specification but supplied by others, however the fuel-oil storage tank is still part of this contract.
- G. Day Tank: Comply with UL 142, Michigan DEQ/LARA, freestanding, factory-fabricated fuel tank assembly set up for outdoor use, with integral, float-controlled transfer pump and the following features:
 - 1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.
 - a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.
 - 2. Tank Capacity: As recommended by engine manufacturer for an uninterrupted period of 4 hours' operation at 100 percent of rated power output of engine-generator system without being refilled.
 - 3. Pump Capacity: Minimum 2 GPM driven by 1/3 HP, 120V 1-phase motor.
 - 4. Control: Provided with On/Off/Emergency run switch, Test/Reset Switch, AC Circuit Breaker, DC Circuit Breaker, and the following indicator lamps:
 - a. Ready (Green) – AC Supply and DC Control Power Available.
 - b. High Fuel (Red) – Latching fault, indicates fuel level near overflow, shuts down pump, and closes N/O dry contacts.
 - c. Low Fuel (Red) – Latching fault, indicates pump failure or operating float switch failure, closes N/O dry contacts.

- d. Low Fuel Shutdown (Red) – Latching fault, indicates near empty tank, closes N/O contacts which may be used to shutdown engine generator to avoid air in the injection system.
 - e. Overflow To Basin (Red) – Latching fault, indicates fuel in overflow/rupture basin, shuts down pump, closes N/O dry contacts
 - f. Spare (Red) – with N/O and N/C dry contacts
 - g. Pump Running (Green)
5. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
 6. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.
 7. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
 8. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
 9. Redundant High-Level Fuel Shutoff: Actuated by high-level alarm sensor in day tank to operate a separate motor control device that disconnects day-tank pump motor. Sensor shall signal solenoid valve, located in fuel suction line between fuel storage tank and day tank, to close. Both actions shall remain in shutoff state until manually reset. Shutoff action shall initiate an alarm signal to control panel but shall not shut down engine-generator set.

2.6 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
- D. Comply with UL 508A.
- E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine-generator set battery. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- F. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 1. AC voltmeter (3-phase, line to line and line to neutral values).
 2. AC ammeter (3-phases).

3. AC frequency meter.
 4. AC kW output (total and for each phase). Display shall indicate power flow direction.
 5. AC kVA output (total and for each phase). Display shall indicate power flow direction.
 6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.
 7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
 8. Emergency Stop Switch: Switch shall be a red "mushroom head" pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
 9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
 10. DC voltmeter (alternator battery charging).
 11. Cranking-limit time delay.
 12. Engine-coolant temperature gage.
 13. Engine lubricating-oil pressure gage.
 14. Running-time meter.
 15. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.)
 16. Fuel tank derangement alarm.
 17. Fuel tank high-level shutdown of fuel supply alarm.
 18. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, over current, over load (kW) short circuit, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.
 19. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
 20. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
 21. Panel lighting system to allow viewing and operation of the control when the generator enclosure is not lighted.
 22. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
 23. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).
- G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- H. Program the control panel's output alarms to the remote annunciators to include, in addition to the NFPA 110 annunciator outputs, Hi Battery, Low Battery, and Weak Battery alarm indication.

- I. Connection to Datalink: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication. Provide connections for datalink transmission of indications to remote data terminals via LonWorks.
- J. Engine-generator control panel heater: Provide an encapsulated thermostatically controlled heater for the engine-generator control panel. The heater shall be arranged to maintain the panel's interior above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article.
- K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation with an integral "flip" style non-lockable cover.
- L. Remote Alarm Annunciators: Provide and install a remote annunciators where indicated on the Drawings. Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
 - 1. Overcrank alarm.
 - 2. Coolant low-temperature alarm.
 - 3. High engine temperature prealarm.
 - 4. High engine temperature alarm.
 - 5. Low lube oil pressure alarm.
 - 6. Overspeed alarm.
 - 7. Low fuel main tank alarm.
 - a. Low fuel level alarm shall be initiated when the level falls below that required for operation for the duration required in "Fuel Tank Capacity" Paragraph in "Diesel Fuel-Oil System" Article.
 - 8. Low coolant level alarm.
 - 9. Low cranking voltage alarm.
 - 10. Contacts for local and remote common alarm.
 - 11. Audible-alarm silencing switch.
 - 12. Control switch not in automatic position alarm.
 - 13. Fuel tank derangement alarm.
 - 14. Fuel tank high-level shutdown of fuel supply alarm.
 - 15. Lamp test.
 - 16. Generator overcurrent protective device not closed.
 - 17. Battery-charger malfunction alarm.
 - 18. Battery low-voltage alarm.
 - 19. Battery high-voltage alarm.
- M. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:
1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.
 3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
 4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
 5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
 6. The protective system provided shall not include an instantaneous trip function.
- A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.
1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
1. Indicate ground fault with other generator-set alarm indications.
 2. Trip generator protective device on ground fault.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.

- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide 12 lead alternator.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance on all alternators rated 30kVA and larger.
- G. Enclosure: Drip-proof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- J. The alternator shall be provided with anti-condensation heater(s) in all applications.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: 18 percent, based on the rating of the engine generator set.

2.9 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Test generator, exciter, and voltage regulator as a unit.
 - 3. Full load run.
 - 4. Maximum power.
 - 5. Voltage regulation.
 - 6. Transient and steady-state governing.
 - 7. Single-step load pickup.
 - 8. Safety shutdown.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner' representative no fewer than five working days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's representative written permission.

3.3 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Equipment Mounting:
 - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.
- D. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.
- E. Installation requirements for piping materials and flexible connectors are specified in Section 335213 "Fuel Distribution and Storage." Copper and galvanized steel shall not be used in the fuel-oil piping system.
- F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.

- C. Connect electrical raceways from the building to the engine-generator set with a short length of liquid-tight flexible conduit. Include a green equipment grounding conductor, sized per NEC, in each raceway.
- D. Connect engine exhaust pipe to engine with flexible connector.
- E. Connect fuel piping to engines with a gate valve and union and flexible connector.
 - 1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 335213 "Fuel Distribution and Storage."
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems." Route a #3/0 bare copper grounding wire from the generator grounding point to the existing #3/0 bare copper grounding wire that circles the entire building. Utilize an exothermically (welded) connection to this existing grounding wire.
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.

3.5 IDENTIFICATION

- A. Identify system components according to Section 260553 "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections before the initial start-up of the new packaged engine generator. The manufacturer's field service representative shall perform the initial start-up.
 - 2. Engage a factory-authorized service representative to perform a four (4) hour on-site test once the unit is installed testing the 208Y/120VAC System as follows:
 - a. Test the engine generator on the load bank for two (2) hours at full load.
 - b. Test the engine generator on the building load for two (2) hours.
 - 3. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect anchorage, alignment, and grounding.
 - 4) Verify the unit is clean.

- b. Electrical and Mechanical Tests
 - 1) Verify phase rotation and phasing,
 - 2) Conduct performance test in accordance with NFPA 110.
 - 3) Verify correct functioning of the governor and regulator.
 4. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 5. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 6. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 7. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- 3.7 SERVICE AGREEMENT:
- A. The supplier shall include in the base price, a one-year service agreement. The maintenance shall be performed by factory authorized service technicians capable of servicing both the engine-generator set and the transfer switches. This agreement shall include the following:

1. Generator supplier must have an in-house rental fleet with equipment sized to back up this project site.
2. All engine maintenance as recommended by the service manual.
3. All electrical controls maintenance and calibrations as recommended by the manufacturer.
4. All auxiliary equipment as a part of the emergency systems.
5. The supplier shall guarantee emergency service.
6. All expendable maintenance items are to be included in this agreement.
7. A copy of this agreement and a schedule shall be given to the Owner at the time of his acceptance, showing what work is to be accomplished and when.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to perform a two (2) hour Owner's maintenance personnel training secession at the jobsite explaining how to adjust, operate, and maintain the new packaged engine generator.

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes automatic transfer switches rated 600 V and less, including the following:
1. Remote annunciator system.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 2. Include material lists for each switch specified.
 3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
 4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Features and operating sequences, both automatic and manual.

- b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 1. Member company of NETA.
 - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 1. Notify Owner no fewer than two weeks in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

- A. Basis of design is Park Detroit, 19197 Sherwood Ave., Detroit, MI 48234, Telephone No. (517) 214-2877, Mr. Robert Treadwell. This is a custom designed and manufactured 30" wide section which includes the automatic transfer switch and rear mounted connection cabinet.
- B. Switchboard manufacturer may be another company if equal in all respects.

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Bus Bracing 65,000A RMS SYM, 65,000A DEV.MIN.INT. Rating based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Service-Rated Transfer Switch:
1. Comply with UL 869A and UL 489.
 2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
 3. In systems with a neutral, the bonding connection shall be on the neutral bus.
 4. Provide removable link for temporary separation of the service and load grounded conductors.
 5. Surge Protective Device: Service rated.
 6. Service Disconnecting Means: Externally operated, manual mechanically actuated.
- L. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- M. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- N. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- O. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- P. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 4. Accessible via rear & front access.
- Q. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using contactor-based components are unacceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching.
 - 4. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 5. Material: Hard-drawn copper, 98 percent conductivity.
 - 6. Main and Neutral Lugs: Compression type.
 - 7. Ground Lugs and Bus-Configured Terminators: Compression type.
 - 8. Ground bar.
 - 9. Connectors shall be marked for conductor size and type according to UL 1008.
- C. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
 - 1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- D. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
 - 1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
 - 2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
 - 3. Fully automatic break-before-make operation with center off position.
 - 4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.
- E. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- F. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- G. Electric Nonautomatic Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- H. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- I. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

- J. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.
- K. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
 12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.
- L. Large-Motor-Load Power Transfer:
1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase

relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

M. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
3. Annunciation panel display shall include the following indicators:
 - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 - b. Switch position.
 - c. Switch in test mode.
 - d. Failure of communication link.
4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
 - a. Indicating Lights: Grouped for each transfer switch monitored.
 - b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 - c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
 - d. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
 1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Undervoltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.
 - f. Temperature rise.
 - g. Dielectric voltage-withstand; before and after short-circuit test.
 - h. Overload.

- i. Contact opening.
- j. Endurance.
- k. Short circuit.
- l. Short-time current capability.
- m. Receptacle withstand capability.
- n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
 - 3. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Connect twisted pair cable according to Section 270500 "Data Communication System."
- G. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.

- H. Final connections to equipment maybe made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. After installing equipment, test for compliance with requirements according to NETA ATS.
 - 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of all control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.
 - k. Perform visual and mechanical inspection of surge arresters.
 - l. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
 - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
 - 3. Electrical Tests:
 - a. Perform insulation-resistance tests on all control wiring with respect to ground.
 - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
 - c. Verify settings and operation of control devices.
 - d. Calibrate and set all relays and timers.
 - e. Verify phase rotation, phasing, and synchronized operation.
 - f. Perform automatic transfer tests.
 - g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.

- 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- D. Coordinate tests with tests of generator and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- F. Transfer switches will be considered defective if they do not pass tests and inspections.
- G. Remove and replace malfunctioning units and retest as specified above.
- H. Prepare test and inspection reports.
- I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265100 – EXIT & EMERGENCY LIGHTING

PART ONE - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Exit signs.
 2. Emergency lighting units.

1.02 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with the latest edition of NFPA 70 accepted by the State of Michigan.

PART TWO - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.02 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- ~~B.~~ Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.03 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, nickel-cadmium type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.04 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS for channel- and angle-iron supports and nonmetallic channel and angle supports.

PART THREE - EXECUTION

3.01 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Adjust aimable lighting fixtures to provide required light intensities.
- D. Connect wiring according to Section 260519 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- E. Connect Emergency Lighting units to remote lighting units as indicated on the Drawings.

3.02 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

END OF SECTION 265100

SECTION 265119 - LED LIGHTING

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior and Exterior solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 SUBMITTALS

- A. Product Data: For each type of product, arranged by designation, as indicated on the Drawings in the Lighting Fixture Schedule.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- D. Qualification Data: For testing laboratory providing photometric data for luminaires.
- E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards along with IESNA LM-79-08.

1.5 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Manufacturer's standard warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- E. IP54 rated driver.
- F. IP65 rated LED optics.
- G. CRI of 70. CCT of 5000 K minimum if not listed in the Lighting Fixture Schedule.
- H. Rated lamp life of 50,000 hours based on IESNA LM-80-08.
- I. Internal driver.
- J. Nominal Operating Voltage: 120 V ac.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.2 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.3 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. J-box or pendant mounting.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Supports: Sized and rated for luminaire weight.
- D. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging. Provide pendant mounted luminaires with a safety chain device.
 - 2. Chain or Cable Mounted, Single-Unit Luminaires: Suspend with chain hangers or aircraft type cable as recommended by the manufacturer.
- E. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- F. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

END OF SECTION 265119

SECTION 270500 - DATA COMMUNICATION SYSTEM

PART ONE GENERAL

1.01 SUMMARY

- A. Provide premise wiring for data and Net distribution, locations as indicated on the Drawings.

1.02 SUBMITTALS

- A. Product data for each product indicated/specified.
 - 1. Cables.
 - 2. Faceplates.
 - 3. Patch panels.
- B. Field Test Report.

1.03 SUBMITTALS

- A. Product data for each type of product specified.
- B. Test data and as-built drawings. Test Data is due to DMVA design department before substantial completion is reached. All data jacks and cable connections systems shall be certified Category 6.

1.04 SYSTEM OVERVIEW

- A. This section specifies the requirements for wire, cable, connections devices, installation, and testing for wiring systems to be used as signal pathways for high-speed data transmission.

1.05 QUALITY ASSURANCE

- A. All cable shall be installed and terminated to meet 100-Base T standards as defined by EIA-TIA-568 standards.
- B. The contractor shall be responsible for the most efficient routing of the cable in conduit. The cable route must avoid any electrical equipment, such as fluorescent lighting, transformers, etc. that could induce noise on the cable.
- C. Codes and Standards
 - 1. IEEE Compliance - Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to communication systems.
 - 2. EIA Compliance - Comply with EIA Standards RS-453, 455, and 464 pertaining to installation of telephone systems.
 - 3. ANSI/ICEA S-80-576 (1988) Communication Wire and Cable for Wiring Premises.
 - 4. NFPA National Electrical Code.
 - 5. REA 345-52 Service Entrance and Station Protector Installations (PC-5A).
 - 6. REA 345-78 Carbon Arrestor Assemblies for Use in Protectors
 - 7. ANSI/T1A/EIA - 568-B.2-1 Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.

PART TWO - PRODUCTS

2.01 CONDUIT, OUTLET BOXES, AND COVER

DATA COMMUNICATION SYSTEM

- A. Provide boxes and conduit in accordance with Sections GENERAL ELECTRICAL REQUIREMENTS.
 - 1. Mount boxes flush in finish walls to match height of 120-volt receptacles, unless indicated otherwise.

2.02 TWISTED PAIR CABLE

- A. All of the data locations shall be wired with unshielded twisted pair (UTP) cable that is category 6 rated and has a total of four (4) pair of copper conductors. The two data cables, shall be separate cables. All of the category 6 rated cable shall be plenum rated.
- B. Data Cable Jacket Color: Cable jacket color shall be factory applied and continuous along the entire length of the cable. Colors as follows:
 - 1. Jacket color for the data cable shall be blue in color.
 - 2. Jacket color for the second data cable shall be blue in color.
- C. The wiring code of the cable will follow the ANSI/TIA/EIT-T568B (AT&T), option B standards

Pair 1	Blue/White	Pin 4
	White/Blue	Pin 5
Pair 2	White/Orange	Pin 1
	Orange/White	Pin 2
Pair 3	White/Green	Pin 3
	Green/White	Pin 6
Pair 4	White/Brown	Pin 7
	Brown/White	Pin 8

2.03 CONNECTORS

- A. All category 6 UTP cabling (Wall Jacks) shall be terminated into snap-in 110 type CAT 6 RJ-45 connectors and meet TIA/EIA-568-B2.1, Cabling Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling. Products from Hubbell are preferred, RJ-45 Model HXJ 6 OR-orange, HXJ 6BL-blue. A minimum of two data jacks will be provided at each customer interface point (voice/data outlet).
 - 1. The top data jack shall be blue in color.
 - 2. The bottom data jack shall be orange in color.

2.04 FACEPLATES

- A. Faceplates shall be high impact 94V-O rated thermoplastic of the appropriate type. Each faceplate shall fit a single-gang box opening and hold two jacks in a vertical orientation. The jack layout and size of the faceplate shall be as follows:
 - 1. Faceplate size: single-gang box opening.
 - a. Jack orientation: Two jacks in vertical alignment.
- B. Data faceplate color shall match the electrical device plate color. If the electrical device plate is metallic, then the voice and data faceplate shall be ivory in color.

2.05 CABLE AND FACEPLATE IDENTIFICATION

- A. The finished installation shall have labeling provided at each end of each cable with a permanent wrap around tag that is 6" from the end of the cable. This label should not be discarded during the installation process.

- B. All faceplates shall have each jack location identified with a permanent label that is neatly applied. This label will include the category of use, and the cable number (EX. To-001); coordinate labeling with DMVA telecommunications mechanic.

2.06 PATCH PANELS AND ADDITIONAL ITEMS:

- A. PATCH PANEL: Basis-of-Design: Hubbell P624 patch panels. Provide the quantity of patch panels to meet requirements of the project (from wall jack count) plus 25% future ports. Patch panel(s) shall have the following specifications.
 - 1. Front access
 - 2. Category 6E
 - 3. T568B 24 port
 - 4. 110 punch-down on rear of panels

PART THREE – EXECUTION

3.01 INSTALLATION

- A. All customer interface (data outlet) boxes shall be 4"x4" boxes with a 2-gang plaster ring.
- B. Install cabling concealed in ceiling and walls. Cabling to be parallel and perpendicular to surfaces, and follow surface contours. Secure and support cables by straps, staples, or similar fittings so designed and installed to avoid damage to cables. Secure cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, or fitting.
- C. Install cabling using techniques, practices, and methods that are consistent with categories and RG type rating at components and that ensure category 6 and RG type performance of completed and linked signal path, end to end.
- D. Install cables without damaging conductor's shields or jackets. A minimum cable installation bending radius shall be observed. Minimum bend radius is defined as a radius of curvature no less than 4 times the outside diameter of the cable.
- E. The contractor shall be responsible for the most efficient routing of the cable in conduit. The cable route must avoid any electrical equipment, such as fluorescent lighting, transformers, etc. that could induct noise on the cable.
- F. Each wall jack location shall have a single, continuous two (2) 4-pair cable pulled to it from the source location. No splices between the patch panel and the wall jack will be accepted. A minimum of 12-inches of excess cable will be left after termination, coiled neatly inside the 4"x4" wall box, and the minimum bend radius for the coil will be observed. A service loop of no less than six feet of excess cable will be neatly coiled above the equipment rack while ensuring that minimum bend radius is observed.
- G. 100% of the category 6 (UTP) cabling will be installed and tested in accordance with T1A/EIA-568-B2.1 Clause 11, Cabling Transmission Performance and Test Requirements. The contractor shall use an electronic testing device to test each cable for the following: (Submit printed output from this test device to DMVA for review.)
 - 1. Attenuation
 - 2. Impedance
 - 3. Capacity
 - 4. Resistance
 - 5. Length
 - 6. dB loss
 - 7. Pin Assignments

8. Continuity
 9. Polarity
 10. Near end cross talk
- H. Scan and test each cable using industry standard equipment for items 1 – 10 above. The results shall be produced in electronic copies and provided to the DOIM/DMVA Network Engineer in MS Excel format.
- I. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and submitted. Electronic submittals are sufficient.
- J. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- K. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

3.02 CABLE IDENTIFICATION

- A. Common Areas & Office Marking Standard:
1. The connection boxes placed on walls or in the bases of cubical furniture shall be labeled clockwise from the main entrance door A1-1, B1-1, A1-2, B1-2, etc around the outside wall, then to interior walls and cubical connections until all interfaces are designated. A1/B1 specifies the patch panel number. The -# specifies the patch panel port number. Top, or blue data jacks, will be labeled as the A drops. Bottom, or orange data jacks, will be labeled as the B drops.
 2. Blue data jacks, (A labeled jacks), will be terminated in patch panels and labeled accordingly at the rack. Orange data jacks, (B labeled jacks), will be terminated in SEPARATE patch panels and labeled accordingly at the rack. The end state is to have A drops and B drops on separate physical patch panels.
 3. Patch panels will be labeled as PP A-1 and PP B-1. When there are more than 24 data drop locations, additional patch panels will be added and labeled PP A-2/PP B-2 and so on. Data drops will reflect this as A2-1,B2-1. This marking would specify PatchPanel A2 Drop #1, PatchPanel B2 Drop #1.

END OF SECTION 270500

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM**PART ONE GENERAL**

1.01 SUMMARY

- A. Section Includes:
1. Manual fire-alarm boxes.
 2. System smoke detectors.
 3. Heat detectors.
 4. Notification appliances.
 5. Fire alarm system pathways.

1.02 SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 2. Detail assembly and support requirements.
 3. Include voltage drop calculations for notification-appliance circuits.
 4. Include performance parameters and installation details for each detector.
 5. Show size and route of cable and conduits and point-to-point wiring diagrams.
 6. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level III minimum.
- C. Qualification Data: For Installer.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 2. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 3. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 4. Device addresses.
 5. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - a. Equipment tested.
 - b. Frequency of testing of installed components.
 - c. Frequency of inspection of installed components.
 - d. Requirements and recommendations related to results of maintenance.
 - e. Manufacturer's user training manuals.
 6. Manufacturer's required maintenance related to system warranty requirements.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

PART TWO - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. The existing Fire-Alarm System is an addressable FA system manufactured by: National Time and Signal, (801) 312-9161. - FACP model 902-SG control unit. Contact National Time and Signal for extension of detection and notification circuit pricing.
- B. Source Limitations for Fire-Alarm System and Components: Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 5. Close smoke dampers in air ducts of designated air-conditioning duct systems (if present on project).
 - 6. Activate emergency shutoffs for gas and fuel supplies (if present on project).
 - 7. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. Independent fire-detection and -suppression systems.
 - 3. User disabling of individual devices.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.
 - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3. Loss of communication with any addressable sensor, input module, relay, control module, or Ethernet module.
 - 4. Loss of primary power at fire-alarm control unit.
 - 5. Ground or a single break in internal circuits of fire-alarm control unit.
 - 6. Abnormal ac voltage at fire-alarm control unit.
 - 7. Break in standby battery circuitry.
 - 8. Failure of battery charging.

9. Abnormal position of any switch at fire-alarm control unit.

E. System Supervisory Signal Actions:

1. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels.
2. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
3. Transmit system status to building management system.
4. Display system status.

2.03 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.04 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type, indicating detector has operated.
 - a. Multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.

- d. Present sensitivity selected.
- e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.05 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 1. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 2. Mounting: Twist-lock base interchangeable with smoke-detector bases.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.06 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 2. Strobe Leads: Factory connected to screw terminals.

2.07 ADDRESSABLE INTERFACE DEVICE

- A. General:
 1. Include address-setting means on the module.
 2. Store an internal identifying code for control panel use to identify the module type.
 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

- C. Control Module:
 - 1. Operate notification devices.
 - 2. Operate solenoids for use in sprinkler service.
 - 3. Control fan motors.

2.08 FIRE-ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
 - 1. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
 - 2. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- B. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 degrees C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.09 PATHWAYS: Install all fire alarm cable in raceway.

- A. EMT (PAINT – Red in color).

PART THREE - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
 - 4. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
 - 5. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

- C. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- E. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- F. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
- G. Remote Device Indicating Lights: Locate in the Mechanical Room above the Fire Alarm Control Panel.

3.03 PATHWAYS

- A. **All fire alarm wiring shall be installed in EMT.**
- B. Exposed EMT shall be painted red enamel.

3.04 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated HVAC duct systems.
 - 2. Supervisory connections at valve supervisory switches.
 - 3. Data communication circuits for connection to building management system.

3.05 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.06 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.07 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by the Owners representative.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- C. Perform tests and inspections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.08 DEMONSTRATION

- A. Demonstrate all relocated and/or new fire alarm circuits are functional.

END OF SECTION 283111

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Removing existing vegetation.
 2. Clearing and grubbing.
 3. Stripping and stockpiling topsoil.
 4. Removing above- and below-grade site improvements.
 5. Disconnecting, capping or sealing, and removing site utilities.
 6. Temporary erosion and sedimentation control.

1.2 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Before beginning site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, water service piping, underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities servicing Project site.
 3. Before digging Call Miss Dig at 800-482-7171.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.
- C. Protect existing site improvements to remain from damage during construction.
 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 1. Arrange with utility companies to shut off indicated utilities.
- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Design Professional not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Design Professional's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING**PART ONE - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, gravel surfaces, pavements, and turf and grasses.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Base course for concrete slabs-on-grade.
6. Excavating and backfilling for utility trenches.

1.02 SUBMITTALS

- A. MDOT certification of subbase material source.
- B. MDOT certification of drainage material source.
- C. Trip Ticket for subbase, drainage and bedding material.
- D. Qualification Data: For qualified testing agency
- E. Material and compaction testing reports.

1.03 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the drainage course and concrete slab on grade.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Design Professional. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Design Professional. Unauthorized excavation, as well as remedial work directed by Design Professional, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.

- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 PROJECT CONDITIONS

- A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.
- B. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures are in place.

PART TWO - PRODUCTS

2.01 MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soil: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, or other deleterious matter.
- C. Unsatisfactory Soil: ASTM D 2487 Soil Classification Groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Subbase Material: Granular Material shall meet MDOT Standard Specification (2012 Edition) Section 902.07 for Class II Material.
- F. Aggregate Surface Material shall meet MDOT Standard Specification (2012 Edition) Section 902 for 21AA or 21A and be crushed clean recycled concrete.
- G. Base Course Material shall meet MDOT Standard Specification (2012 Edition) Section 902 for 21AA or 21A except where indicated below:
 - 1. Recycled pavement crushings may be used as base material following conditions are met.
 - a. Crushings are 2 inch minus and are crushed to a consistent gradation.
 - b. Crushings are approved for use by the Design Professional.
 - c. Base compaction requirements must be met.

- H. Shoulder Material: Granular Material shall meet MDOT Standard Specification (2012 Edition) Section 902 for 22A and be crushed limestone or clean recycled concrete.
- I. Bedding Coarse: Granular Material shall meet MDOT Standard Specification (2012 Edition) Section 902.07 for Class II Material.

2.01 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

PART THREE - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

3.02 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches

3.03 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.04 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
- B. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.05 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.06 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit or unless indicated otherwise on drawings.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
- D. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.

3.07 SUBGRADE INSPECTION

- A. Notify DMVA when excavations have reached required subgrade.
- B. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Design Professional, without additional compensation.

3.08 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Design Professional.
- B. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Design Professional.

3.09 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.

- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings to 18 inches below bottom of footings with subbase material; fill with concrete to elevation of bottom of footings.
- D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 SOIL FILL

- A. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use Class II Sand.
 - 4. Under building slabs, use Class II Sand.
 - 5. Under footings and foundations, use Class II sand.

3.12 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.14 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch Insert dimension.
 - 3. Pavements: Plus or minus 1/2 inch.
 - 4. Aggregate Surface Courses: Plus or minus 3/4 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.15 SUBBASE AND BASE COURSES UNDER PAVEMENTS, GRAVEL SURFACES AND WALKS

- A. Place subbase course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and shoulders as follows:
 - 1. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 2. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
 - 3. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.16 FIELD QUALITY CONTROL

- A. Proof-roll subgrade below slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by DMVA, and replace with compacted backfill or subbase as directed.
- B. Testing Agency: Engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Design Professional.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved, Gravel Surfaces, and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area, gravel surface, or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
3. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Scarify or remove and replace soil material to depth as directed by Design Professional; reshape and recompact.
- D. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
- E. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Transport surplus soil to designated storage areas on Owner's property within 1 mile of work area. Stockpile or spread soil as directed by DMVA.
- B. Burning on Owner's Property is not permitted.

END OF SECTION 312000

SECTION 312500 - SOIL EROSION AND SEDIMENTATION CONTROL**PART ONE - GENERAL**

1.01 DESCRIPTION

- A. Provide earthwork in compliance with Michigan Soil Erosion and Sedimentation Control Act (P. A. Act 451, 1994) and its corresponding rules, including subsequent revisions.
 - 1. DMVA is the permitting and enforcing agency on this Project.

1.02 SUBMITTALS

- A. Contractor is to submit required items listed in this Section to DMVA Environmental including request for Permit.

PART TWO – PRODUCTS

2.01 MATERIALS

- A. Silt Fence shall meet Section 916.02 of MDOT 2012 Standard Specifications for Construction.
- B. Inlet Protection shall be as shown on drawings or in accordance with Section 916.04 of MDOT 2012 Standard Specifications for Construction.
- C. Geotextile liner shall meet requirements of Section 910.01 of MDOT 2012 Standard Specifications for Construction.

PART THREE – EXECUTION

- A. The Contractor shall be responsible for all control measures to prevent damage resulting from erosion and sedimentation to on-site or off-site areas and as described in this Section. The Contractor is to provide all materials and labor necessary to complete erosion control measures. Materials, installation, and performance standards shall comply with guidelines set forth by Act 451 of the Public Acts of 1994, Part 91, “The Michigan Soil Erosion and Sedimentation Control Act”; the Michigan Unified Keying System can be referenced to the measures outlined in the Michigan Soil Erosion and Sedimentation Control Guide Book.
- B. Prior to start of earthwork, the contractor must submit a Soil Erosion and Sedimentation Control Implementation Plan.
 - 1. Upon approval of the Contractor’s plan, AUTHORIZATION TO PROCEED WITH EARTH CHANGE will be issued and must be posted at the site.
- C. SESC measures required by contract drawings and as submitted by contractor to meet soil erosion plan and Act 451, Part E, must be installed before earth change operations begin.
- D. Failure to comply with planning and execution of SESC measures listed in A, B, & C above before earth change begins may result in fines of up to \$500 per day and/or assessment of actual damage costs.
- E. Any areas of stockpiled soil shall be limited to a 30 day period prior to instituting final and/or temporary soil erosion measures as directed by the Contracting Officer.
- F. Daily SESC inspection reports shall be completed by the Contractor and be kept on site in a 3-ring binder for DMVA inspection at any time.

- G. Repairs to damaged or inadequate SESC measures shall be performed without delay.
- H. Based on on-site conditions, the SESC Program inspection team may make “minor” adjustments to the overall SESC strategy such as relocating or adding silt fence, check dams, or modifying inlet protection controls. Any “major” deviations from the plan requirements specified by the SESC Team will be handled as a contract modification.
 - 1. Prior review and approval is not required if the changes are needed to mitigate the effects of a pending sediment release.
- I. Erosion and any sedimentation generated from work on site shall be contained on the site and not be allowed to collect on any off-site areas or in waterways. Waterways include both natural and man-made open ditches, streams, and storm drains.
- J. Erosion and sediment control measures are to be placed prior to, or as the first step in, construction. Sedimentation control practices will be applied as a perimeter defense to prevent any loss of silt from the site.
- K. Contractor shall be responsible for the installation and application of all erosion and sedimentation control measures required to preclude damage to on or off-site properties and structures. These erosion and sedimentation control measures shall be removed upon the permanent stabilization of slopes, ditches, mounds, etc.
- L. Permanent soil erosion control measures for all slopes, channels, ditches, or any disturbed land area shall be completed within 15 calendar days after final grading or the final earth change has been completed. When it is not possible to permanently stabilize a disturbed area after an earth change has been completed or where significant earth change activity ceases, temporary soil erosion control measures shall be implemented within 15 calendar days there from.
- M. Silt Fence and Fabric – Fencing shall be installed so as to allow filter fabric to be installed and remain taut and upright. Contractor shall maintain this condition of fencing at all times during construction. The bottom of the fence must be “toed” into the ground per manufacturer’s recommendations. The fabric shall allow the movement of storm water through it but not permit the passage of soil.
 - 1. Filter fence shall not exceed 30" in height; fabric shall be continuous between posts, with splices occurring only at wood posts; posts shall be spaced 10'-0" o.c.; a 4" x 4" trench shall be excavated along line of posts and up slope from barrier; the trench shall be backfilled and the soil compacted over the filter fabric.
- N. Slopes steeper than a 4-to-1 gradient shall be protected with erosion control blankets (mulch blankets) see Section 329200 “Turf and Grasses”. Erosion control blankets shall be installed in strict accordance with manufacturer’s recommendations, and the Michigan Soil Erosion and Sedimentation Control Guide Book.

END OF SECTION 312500

SECTION 321739 – VEHICLE W-BEAM GUIDE RAIL**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes W-beam guide rail.

1.2 SUBMITTALS

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

1.3 REFERENCED STANDARDS

- A. MDOT 2012 Standard Specifications for Construction.
- B. MDOT Standard Plans Series R-60-J.

PART 2 - PRODUCTS

2.1 W-BEAM GUARD RAIL

- A. Shall meet the requirements of the following:
 - 1. MDOT Standard Plan Series R-60-J, Type A, steel post.
 - 2. MDOT 2012 Standard Specifications for Construction, Section 908.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not begin installation before final grading is completed unless otherwise permitted by Design Professional.
- B. Install as required by the following:
 - 1. MDOT Standard Plan Series R-60-J, Type A, steel post.
 - 2. MDOT 2012 Standard Specifications for Construction, Section 807.

END OF SECTION 321739

SECTION 329200 - TURF AND GRASSES**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
 - 1. Seeding.
 - 2. Hydroseeding.

1.2 SUBMITTALS

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

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

1.4 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. Southern Lower Peninsula South of the North boundary of Township 20 North.
 - a. April 15 through October 10.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: State certified seed of grass species as follows:
 - 1. MDOT TDS Seed Mixture - Creeping Red Fescue 45%; Perennial Rye Grass 25%, Hard Fescue 25%, Kentucky Blue Grass 5%, mixture to be certified by tag on each bag. All species shall have minimum purity of 97% and a germination of 85%.

2.2 FERTILIZERS

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 12 percent nitrogen, 12 percent phosphorous, and 12 percent potassium, by weight.

2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- D. Mulch Blanket:
 1. Netting:
 - a. The blankets must have net covering on one side.
 - b. The net must provide the necessary reinforcement for protecting the blanket during shipping, handling, and installation.
 - c. Use net with a mesh size not larger than 1 1/2 by 2 inches nor smaller than 1/2 by 1/2 inch.
 - d. The netting must be fabricated from a plastic that has been formulated from or treated with a chemical which will promote the breakdown of the net within the first growing season after placement.
 - e. The netting must have sufficient strength to hold the mulch in place and still deteriorate rapidly upon exposure to sunlight.
 2. Blanket:
 - a. Made from a uniform layer of straw.
 - b. The straw must be clean wheat straw free of weeds and weed seed.
 - c. The straw and net covering must be securely stitched together to create a uniform mat.
 - d. The blankets must weigh (dry) 8 ounces per square yard, ± 10 percent.
 - e. Weight of each roll and name of manufacturer must be written or stenciled on the roll wrapper or on an attached tag.
 - f. Blankets must be shipped in the form of a tightly compressed roll.
 - g. Use net anchors of the material and design specified by manufacturer, except do not use steel wire staples or pins to anchor mulch blankets or netting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 2. Protect grade stakes set by others until directed to remove them.

3.3 TURF AREA PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Spread 4 inches manufactured topsoil, apply fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
- B. Finish Grading - Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Design Professional's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING AND MULCHING GENERAL

- A. Contractor has option of seeding with straw mulch or hydroseeding.**

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:4 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.6 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with nonasphaltic tackifier.
 - 2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.7 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow to a height of 2 to 3 inches.

3.8 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Design Professional:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.10 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
 - 1. Seeded Turf: 60 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

END OF SECTION 329200

SECTION 335213 – FUEL DISTRIBUTION AND STORAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Perform all Work required to provide and install fuel oil piping and storage system.
- B. Provide a complete integrated emergency fuel system for the diesel driven generator as shown in the Contract Documents. This specification requires system coordination, design, equipment, installation guidance, programming, startup, training and fuel stabilization treatment to be the responsibility of a single specialized fuel system supplier. This specification section includes Contractor responsibility for all materials, labor, design, code compliance, permits, inspections, piping, specialty components, fuel leak detection, fuel monitoring, and control systems installation. The system shall be in accordance with design standards and shall be designed and built for reliability. Fuel equipment supplier shall be responsible for all field control wire and conduit associated with the fuel system to ensure a fully functional and coordinated system and maintain a single point of system responsibility.

1.2 PIPING SYSTEM DESCRIPTIONS

- A. Aboveground, Fuel Piping and Vent Piping: Use the following piping materials for each size range:
 - 1. NPS 2 and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
- B. Valve Applications: Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Fuel Oil Shutoff Duty: Use ball valves.

1.3 DEFINITIONS

- A. Fuel Oil: Includes diesel fuel oil for diesel engines.
- B. The following are industry abbreviations for storage tanks:
 - 1. AST: Aboveground storage tank
- C. STI: Steel Tank Institute.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Use flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system's pressure rating in aboveground and containment sump applications, unless otherwise indicated.
- B. Minimum working-pressure ratings for piping are the following, unless otherwise indicated:
 - 1. Fuel Distribution Piping: 150 psig.
 - 2. Vent, Gage, and Fill Piping Minimum Working-Pressure Rating: 100 psig.
- C. Minimum test-pressure ratings for fuel storage tanks are the following:
 - 1. Containment Shell, Smaller Than 12-Foot Diameter: 5 psig.
 - 2. Inner Tank, 12-Foot and Larger Diameter: 3 psig.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Piping.
 - 2. Valves.
 - 3. Each type and size of fuel storage tank. Indicate dimensions, weights, loads, components, and location and size of each field connection.
 - 4. Fuel storage tank accessories.
 - 5. Fuel storage tank piping specialties.
 - 6. Liquid-level gage systems.
 - 7. Leak-detection and -monitoring systems.
 - 8. Fuel polishing system.
- B. Shop Drawings:
 - 1. For AST supports and anchors. Include plans, elevations, sections, and details.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Layout and connection diagram showing location of all equipment, vents, grounding requirements and pipe routing.
- C. Material Certificates: For each fuel storage tank, signed by manufacturers.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fuel storage tank pumps and leak-detection and -monitoring systems to include in operation and maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of fuel storage tanks and are based on specific units indicated. Refer to Division 01 Section "Product Requirements."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with ASME B31.3, "Process Piping," for fuel piping.
- E. Comply with NFPA 30, "Flammable and Combustible Liquids Code," for design, construction, installation, testing, and inspection of fuel distribution systems.
- F. Comply with requirements of the EPA and state and local environmental-protection authorities having jurisdiction. Include recording of fuel storage tanks and monitoring of tanks and piping.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support fuel storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.
- B. Prepare fuel storage tanks and accessories for shipping as follows:
 - 1. Ensure that units are dry and internally protected against rust and corrosion.
 - 2. Protect fuel storage tank accessories and piping connections against damage.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 PERMITS

- A. **Apply for all necessary permits and plan review required for an above ground fuel storage tank including fees.**

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel storage tanks that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following when used for storage of fuel at temperatures not exceeding 150 deg F:
 - a. Structural failure including cracking, breakup, and collapse.
 - b. Corrosion failure including external and internal corrosion of steel tanks.
 - 2. Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 1 "Piping Systems Description" Article for applications of pipes, tubes, fittings, valves, and joining materials.

2.3 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53, Schedule 40, Type S or E, Grade A or B, black.
 - 1. Steel Threaded Fittings: ASME B16.11, with threads according to ASME B1.20.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threads according to ASME B1.20.1.

3. Malleable-Iron Unions: ASME B16.39, Class 150. Include brass-to-iron seat, ground joint, and threads according to ASME B1.20.1.
- B. Transition Couplings:
1. Aboveground, Fuel Piping: Manufactured coupling or fitting or companion flanges same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- C. Flexible Connectors: UL-listed, flexible piping 96 inches or less in length.
1. Metallic Connectors: For connection to aboveground, fuel tanks.
 - a. Manufacturers:
 - 1) FLEX-ING, Inc.
 - 2) Hose Master, Inc.
 - 3) Jackson Industries.
 - 4) Teleflex Fluid Systems, Inc.

2.4 VALVES

- A. Bronze Ball Valves: MSS SP-110; 3-piece bolted-body; 400-psig- minimum, WOG, nonshock, working-pressure rating. Include full-port, cast-bronze, chrome-plated bronze ball; PTFE seats; lever handle; and threaded ends according to ASME B1.20.1. Valves with solder ends may be furnished for use with copper tube.
- B. Bronze Check Valves: MSS SP-80, Type 3, Class 200. Include ends threaded according to ASME B1.20.1. Valves with solder ends may be furnished for use with copper tube.
- C. Bronze Vertical Ball Check Valves: ASTM B 61 or ASTM B 62, 2-piece construction; and 400-psig WOG, nonshock, working-pressure rating. Include integral bronze seats, replaceable stainless-steel ball, and threaded ends according to ASME B1.20.1.
- D. UL Valves: UL 842, listed for fuel oil service.
- E. Special-Purpose, General-Duty Valves: Valves made in shape or configuration for specific fuel oil service and complying with requirements of NFPA 30.
- F. Pressure-Reducing Valves: UL listed for fuel oil service. Include bronze body with 150- psig minimum pressure rating.
1. Manufacturers:
 - a. Anderson, Greenwood & Co.; Kunkle Valve Div.
 - b. Fulflo Specialties, Inc.
 - c. Webster Fuel Pumps & Valves; a division of Capital City Tool, Inc.
 - d. Franklin Fueling 664.

2.5 FIRE-SAFE BALL VALVES

- A. Ferrous-Alloy Ball Valves, General: MSS SP-72, with ASTM A-216 Type WCB, carbonsteel body; ASTM A-351, Type CF8M vented stainless-steel ball; and ASTM A-276, Type 316 stainless-steel stem; fire rated according to API 607 (4th edition); and having flanged ends and blowout-proof stem.
- B. Class 150, Regular-Port, Ferrous-Alloy Ball Valves: Uni-body construction, glassreinforced TFE seats; 285 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Metso Automation; Jamesbury Valves.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.; Model F-510-CS-R-66-FS.

2.6 ABOVEGROUND DOUBLE WALL TANK

- A. Basis-of-Design is HT-1105, Fireguard, cylindrical, 3000 gallon, manufactured by Highland Tank or an approved equal.
- B. Manufacturers:
 1. Cardinal Tank Corp.
 2. Containment Solutions, Inc.; Hoover Containment Div.
 3. ConVault, Inc.
 4. Earthsafe.
 5. EcoVault, Inc.
 6. Highland Tank.
- C. Description: UL 142 and UL 2085; thermally insulated, fire-resistant, and protected; double-wall; horizontal; steel tank; with primary- and secondary-containment walls and insulation and with interstitial space for leak-detection sensor.
- D. Construction: Fabricated with welded, carbon steel and insulation, suitable for operation at atmospheric pressure and for storing fuel with specific gravity up to 1.1 and with test temperature according to UL 2085.

2.7 AST ACCESSORIES

- A. Tank Manholes: 24-inch minimum diameter; bolted, flanged, and gasketed; centered on top of tank.
- B. Pipe connection fittings on top of tank, for fill, supply, return, vent, sounding, leak detection, and gaging. Include cast-iron plugs for shipping.
- C. Polishing system pickup tube: Provide a 2" flange at the top of the tank for the diesel fuel polishing system.
- D. Striker Plates: Inside tank, on bottom below fill, vent, sounding, gage, and other tube openings.
- E. Lifting Lugs: For handling and installation.
- F. Stairs with Landing: Provided by tank manufacturer, Basis of Design is Containment Solutions, Product Code STB014, galvanized.

2.8 FUEL STORAGE TANK PIPING SPECIALTIES

- A. Manufacturers:
 1. EBW, Inc.
 2. EMCO Wheaton DTM, Inc.

3. Environ Products Inc.
 4. McDonald, A. Y. Mfg. Co.
 5. Morrison Bros. Co.
 6. OPW Fueling Components.
 7. Petroleum Containment Composites.
 8. Preferred Utilities Manufacturing Corp.
 9. Smith Fibercast; a Varco Company.
 10. Universal Valve Company.
- B. Fitting Materials: Cast-iron, malleable-iron, brass, or corrosion-resistant metal; suitable for service.
1. Aboveground-Mounted Fittings: Weatherproof.
- C. Spill-Containment Fill Boxes: Flush mounting, with drainage feature to drain fuel into tank, threaded fill-pipe connection, and wrench operation.
- D. Fill Boxes: Flush mounting, with threaded fill-pipe connection and wrench operation.
- E. Supply and Sounding Drop Tubes: Fuel supply piping or fitting, inside tank, terminating 6 inches above bottom of tank, and with end cut at a 45-degree angle.
- F. Pipe Adapters and Extensions: Compatible with piping and fittings.
- G. Suction Strainers and Check Valves: Bronze or corrosion-resistant metal components.
- H. Foot Valves and Antisiphon Valves: Poppet-type, bronze or corrosion-resistant metal components.
- I. Weatherproof Vent Cap: Increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
- J. Metal Manholes: 24-inch- minimum diameter frame and cover. Furnish manhole units of adequate size for access to fittings if size is not indicated.
- K. Monitoring Well Caps: Locking pipe plug and manhole.
- 2.9 LIQUID-LEVEL GAGE SYSTEMS
- A. Manufacturers:
1. Amprodux, Inc.
 2. Caldwell Systems.
 3. Clawson Tank Company.
 4. EBW, Inc.
 5. Highland Tank & Mfg. Co.
 6. Intelligent Controls, Inc.
 7. King Engineering Corp.
 8. Krueger Sentry Gauge.
 9. Pneumercator Inc.
 10. Preferred Utilities Manufacturing Corp.
 11. Rochester Gauges, Inc.
 12. Tuthill Corporation; Tuthill Transfer Systems; Emco Electronics Div.

13. Uehling Instrument Company.
14. Venture Measurement Co.

- B. Description: Calibrated, liquid-level gage system complying with UL 1238 with probes or other sensors and remote annunciator panel.
- C. Probes: Made for tank mounting and suitable for use in fuel.
- D. Annunciator Panel: With visual and audible, high- and low-tank-level alarms, fuel indicator with registration in gallons, and overfill alarm. Include gage volume range that covers fuel storage capacity.
- E. Controls: Electrical, operating on 120-V ac power.

2.10 LEAK-DETECTION AND -MONITORING SYSTEMS

- A. Manufacturers:
 1. Amprodux, Inc.
 2. Caldwell Systems.
 3. Containment Solutions, Inc.
 4. EBW, Inc.
 5. Gems Sensors Inc.
 6. Highland Tank & Mfg. Co.
 7. In-Situ, Inc.
 8. Intelligent Controls, Inc.
 9. Marley Pump Co.
 10. MSA International; Instrument Div.
 11. Pneumercator Inc.
 12. Raychem Corp.
 13. Tuthill Corporation; Tuthill Transfer Systems; Emco Electronics Div.
 14. Veeder-Root.
- B. Description: Calibrated, leak-detection and -monitoring system complying with UL 1238 with probes and other sensors and remote alarm panel for fuel storage tanks and fuel piping. Include fittings and devices required for testing.
- C. Description: Calibrated, leak-detection and -monitoring system and liquid-level gage system complying with UL 1238 with probes and other sensors and remote alarm panel for fuel storage tanks and fuel piping.
- D. Hydrostatic-Monitoring System: Comply with UL 1238, with brine antifreeze solution, reservoir sensor, electronic control panel to monitor leaks in inner and outer tank walls, and electrical controls operating on 120-V ac power.

2.11 FUEL POLISHING SYSTEM

- A. Basis-of-Design Fueltec Systems LLC, Model CF4.0-UL-PLC v_1.0, Automatic 4 GPM Fuel Polishing System with Pre-Filter or approved equal.
 1. Complete factory-assembled automatic particulate filtration, water separation and removal system to maintain the purity of No. 2 fuel oil held in extended storage. The system shall

- circulate the oil from the storage tank, through the system, removing water and particulate matter, then returning the clean dry fuel back to the storage tank.
2. The System shall exceed diesel engine manufacturer's cleanliness target of ISO 18/16/13. Water removal to less than 100 PPM.
 3. The system shall separate free and emulsified water from diesel fuel with a military type micro-glass coalescer/filter and hydrophobic water separator within a stainless steel top loading housing. Water absorbing filter media is not required.
 4. System shall have a touch screen HMI and PLC controller that schedules system operation with alarms and sensors that automatically indicate filter conditions, presents of water in trap, and fluid leak. System includes Modbus networking kit.
 5. Industrial electric control panel shall be Underwriters Laboratory 508A and CE Listed.
 6. System shall be installed with supply and return piping that is exclusive to the system and independent of any other piping to or from the storage tank(s). System supply piping shall extend to contact the storage tank bottom and be designed to maintain contact with the storage tank bottom to extract even small droplets of water.
- B. The filtration system shall consist of but not limited to the following components:
1. Welded rain tight aluminum equipment enclosure 42"x14"x36" mounted to a 6"x6" aluminum post.
 2. Five stage filtration and water removal.
 - a. First stage pre-filter spin-on 3 micron.
 - b. Second, third, and fourth stage filter/coalescer within a stainless steel housing:
 - 1) Treated cellulose.
 - 2) Micro-glass.
 - 3) Hydrophilic cloth wrap.
 - c. Fifth stage water separator Teflon coated stainless steel.
 3. Fuel circulation pump bronze 4 GPM w/pressure relief 115/230V 1PH 50/60Hz.
 4. Stainless steel separated water trap one gallon capacity with bottom drain valve.
 5. Valves: supply and return valves shall be 1" ball valves, drain 1/2" ball valve.
 6. Sensors:
 - a. Vacuum sensor transmits condition of first stage filter to HMI/PLC.
 - b. Pressure sensor transmits condition of filter/coalesce to HMI/PLC.
 - c. Water sensor transmits high & low water levels in water trap.
 7. Electrical:
 - a. Industrial Control Panel Underwriters Laboratory UL-508A and CE listed.
 - b. Power required: 115AC 1PH 50/60 Hz 20A.
 - c. Enclosure NEMA 4X.
 - d. Voltage: high 115AC, low 24DC.
 8. Controller: HMI/PLC touch screen.
 - a. Programmable: date, time, tank selection, run time.
 - b. Display:
 - 1) Low water in trap.
 - 2) Vacuum at primary filter (filter change instructions).
 - 3) Pressure at final filter (filter change instructions).
 - 4) High water in trap (drain separated water).
 - 5) System on.
 - 6) Tank selected for filtration.
 - 7) Day selected for filtration.
 - 8) Run time selected for filtration.
 - 9) Time of day.
 - c. Alarms:

- 1) High water in trap.
- 2) High vacuum (service primary filter).
- 3) High pressure (service final filters).
- 4) Fluid in system sump.
- 5) No fluid flow.

2.12 SOURCE QUALITY CONTROL

- A. Test and inspect fuel storage tanks, after fabrication and before shipment, according to the following:
 1. Horizontal, Concrete-Vaulted, Steel ASTs: UL 142 and UL 2085.
- B. Verification of Performance: Rate fuel storage tanks according to applicable standards.

2.13 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish one set of extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Primary filter.
 2. Micro-glass coalescer.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Supply and install all piping and components for a working fuel distribution system.
- B. Install piping free of sags and bends.
- C. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- D. Install fittings for changes in direction and branch connections.
- E. Assemble and install bulkhead fittings for pipe penetrations through storage tank sump sidewalls. Follow fitting manufacturer's written instructions and use components required for liquid-tight joints.
- F. Install reductions in pipe sizes using eccentric reducer fittings. Install fitting with level side down.
- G. Install flexible hoses or pipe connectors at piping connections to ASTs and vibration producing equipment. Use according to the following applications:
 1. Steel Piping: Stainless-steel-hose, flexible connectors.

3.3 VALVE INSTALLATION

- A. Install valves in accessible locations. Protect valves from physical damage, and install metal tag attached with metal chain indicating fuel piping systems.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 AST INSTALLATION

- A. Install ASTs according to manufacturer's written instructions and standards specified.
- B. Install tank bases and supports.
- C. Set tanks on bases and supports.
- D. Install piping connections and vent fittings.
- E. Install ground connections.
- F. Install tank leak-detection and -monitoring devices.
- G. Install aboveground concrete-vaulted storage tanks in accordance with NFPA 30, 30A, and 31 and UFC Appendix II-F.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- E. Connect wiring according to Section 260519 "Low –Voltage Electrical Power Conductors and Cables."
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 LIQUID-LEVEL GAGE SYSTEM INSTALLATION

- A. Install liquid-level gage systems according to manufacturer's written instructions. Locate panel inside building where indicated.

3.8 LEAK-DETECTION AND -MONITORING SYSTEM INSTALLATION

- A. Install leak-detection and -monitoring systems according to manufacturer's written instructions. Install alarm panel inside building where indicated.
 - 1. Double-Wall Fuel Storage Tanks: Install probes or use factory-installed integral probes in interstitial space.
 - 2. Install liquid-level gage systems according to manufacturer's written instructions.

3.9 FUEL POLISHING SYSTEM

- A. Install fuel polishing system according to manufacturer's written instructions and standards specified.
- B. Coordinate with AST manufacturer for piping locations.

3.10 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each AST and on equipment exposed in sumps and manholes.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 - 2. Provide all signage required by authorities having jurisdiction.
- B. Fuel Piping: Pipe shall be labeled and painted the appropriate color in accordance with ANSI A13.1. The labels shall have proper identification for supply piping (Fuel Oil DS) and for return piping (Fuel Oil DR) Fuel Oil Vent, Fuel Oil Fill and Fuel Oil Drain, etc.

3.11 FIELD QUALITY CONTROL

- A. Perform field tests on underground piping before backfilling.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Test fuel piping according to NFPA 30, "Piping Systems" Chapter on testing or NFPA 31, "Piping, Pumps, and Valves" Chapter on tests of piping.
 - a. Hydrostatically test carrier piping to 1-1/2 times system pressure.
 - b. Pneumatically test containment jacket at maximum 5 psig (35 kPa).
 - 2. Test fuel storage tanks according to NFPA 30, "Tank Storage" Chapter on testing and maintenance or NFPA 31, "Tank Storage" Chapter on testing and maintenance.

3. Test liquid-level gage systems for accuracy by manually measuring fuel levels at not less than three different depths while filling tank and checking against gage indication.
4. Test leak-detection and -monitoring systems for accuracy by manually operating sensors and checking against alarm panel indication.

C. Remove and replace units and retest as specified above.

3.12 ADJUSTING

- A. Adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.13 FUEL FILL AND TREATMENT

- A. Coordinate with project testing schedules. Upon completion of all generator load testing and prior to final fueling of system, fuel system winter-time treatment shall be added to storage tanks, amount as required, even if completed during non-winter months.

- B. Fill main fuel storage tank at Project completion with appropriate fuel, including generator day tank.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain leak-detection and -monitoring systems, polishing system and fuel storage tank pumps.

END OF SECTION 335213

APPENDIX I
GLOSSARY

GLOSSARY

Activity– An element in the Progress Schedule establishing a requisite step, or the time and resources required, for completing the part of the Work associated with that Activity.

Addenda– Written instruments that are used by the Owner and/or Professional to incorporate interpretations or clarifications, modifications, and other information into the Bidding Documents. An Addendum issued after Bid opening to those Bidders who submitted a Bid, for the purpose of re-bidding the Work without re-advertising, is referred to as a **post-Bid Addendum**.

Agency- Any unit, section, division, department, or other instrumentality of the State that benefits from the Work.

Alternate– Refers to work specified in the Bidding Documents for which the Bidder must bid a Bid Price.

Apparent Low Bidders: Those Bidders whose Base Bid, when added to those specific Alternates the Owner intends to accept, yields the three lowest sums of Bid and Alternates. Additional Bidders may be considered Apparent Low Bidders if their Bid, when added to those specific Alternates the Owner intends to accept, yields a sum within 10% of the lowest of the Apparent Low Bidder's sum. If a qualified disabled veteran meets the requirements of the contract solicitation, provides acceptable responses to both Part One and Part Two of the Best Value Construction Bidder Evaluation to achieve a Best Value recommendation and with the veteran's preference is the lowest responsive, responsible, best value Bidder it is considered the Apparent Low Bidder.

Archaeological Feature– Any prehistoric or historic deposit of archaeological value, as determined by a representative of a State Agency that is duly authorized to evaluate such findings and render such judgments. An Archaeological Feature deposit may include, but is not limited to Indian habitations, ceremonial sites, abandoned settlements, treasure trove, artifacts, or other objects with intrinsic archaeological value and that relate to the history and culture of the State of Michigan. The Archaeological Features are listed under Section 00800 Supplementary Conditions.

Authorized Technical Data– Information and data contained in a report of exploration and tests of subsurface conditions. Also, any physical data (dimension, location, conditions, etc.) contained in those Drawings of physical conditions of existing surface and subsurface facilities.

Best Value- The bids will be evaluated for best value based on price and qualitative components that may include but are not limited to technical design, technical approach, quality of proposed personnel, and management plans, per PA 430 of 2012.

Bid– Written offer by a Bidder for the Work, as specified, which designates the Bidder's Base Bid and Bid Prices for all Alternates. The term *Bid* includes a *re-bid*.

Bidder– The Person acting directly, or through an authorized representative, who submits a Bid directly to the **Owner**.

Bidding Documents– The proposed Contract Documents as advertised, and all Addenda issued before execution of the Contract.

Bid Price– The Bidder's price for a lump sum item of work, or the product of the Bidder's unit price for an item of Unit Price Work times the quantity given on the Bid Form for that item.

Bid Security– A security serving as a guarantee that the Bidder will conform to all conditions.

Bidding Requirements–The Advertisement, Instructions to Bidders, Supplementary Instructions, Information for Bidders, Bid Form, Bid Form Attachments, and qualification submittals, as advertised and as modified by Addenda, and any other Section included within Division 0 of the Bidding Documents for the purpose of governing bidding and award of the Contract.

Board– The Administrative Board of the State of Michigan.

Bond– Security furnished by the **Contractor**, as required by the Contract Documents.

Business Day– Any Day except Saturdays, Sundays and holidays observed by the **Owner**.

Bulletin– A request used by the **Owner** to describe a change in the Work under consideration by the **Owner** and to request the **Contractor** to submit a proposal for the corresponding adjustment in Contract Price and/or Contract Time, if any.

Calendar Day– Every day shown on the calendar, Saturdays, Sundays, and holidays included.

Cash Allowance– An **Owner**-specified sum included within the Contract Price to reimburse the **Contractor** for the actual purchase/furnished cost of materials and/or equipment or other designated items, as specifically provided in the Contract Documents. Although the scope (e.g., the required quantity) of any Work covered by a Cash Allowance is sufficiently detailed in the Contract

Documents for the purposes of bidding the required labor costs, Subcontract costs, construction equipment costs and general conditions costs and Fee, it is understood that the required materials, equipment or other designated items are of uncertain purchase cost at the time of Bid or are yet to be specified in more detail by the **Professional** as to quality, appearance, durability, finish and such other necessary features affecting purchase price.

Change Order– A written order issued and signed by the **Owner**, which amends the Contract Documents for changes in the Work or an adjustment in Contract Price and/or Contract Time, or both.

Contract Award– The official action of the **Board**, the **Director-SFA** or the **Director-DCD** awarding the Contract to the **Contractor**.

Contract Documents– Written and graphic documents that form the legal agreement between the **Owner** and the **Contractor**, consisting of this document, completed Bid and Contract forms, terms and conditions of the contract, specifications, drawings, addenda, Notice of Award, Notice-to-Proceed and contract change orders.

Contract Price– The total compensation, including authorized adjustments, payable by the **Owner** to the **Contractor** (subject to provisions for Unit Price Work).

Contract Times–The Contract Times for the entire Work are the periods allowed, including authorized adjustments, for Substantial Completion and final completion of the Work. The Contract Times for a designated portion of the Work are the periods allowed for Substantial Completion and final completion of any such portion of the Work, as specified in the Contract Documents.

Contractor– Business enterprise with which the **Owner** has entered into the Contract.

Correction Period– A period during which the **Contractor** must, in accordance with the Contract Documents, (a) correct or, if rejected, remove, and replace Defective Work, and (b) maintain warranties for materials and equipment in full force and effect.

Cost of the Work Involved– The sum of all costs that would be, or were, necessarily incurred by the **Contractor** in providing any Work Involved with the related change, less the costs that would be, or would have been, incurred by the **Contractor** to provide such Work without the related change.

Defective– As determined by the Professional, an adjective which when referring to or when applied to the term “Work” refers to (a) Work not conforming to the Contract Documents or not meeting the requirements of an inspection, test, or approval, or (b) Work itemized in a Punch List which the **Contractor** fails to complete or correct within a reasonable time after issuance of the Punch List by the **Professional**.

Delay– Any act or omission or other event that in any manner adversely affects or alters the schedule, progress or completion of all or any part of the Work. Delay is a generic term intended to include deferral, stoppage, slow down, interruption and extended performance, and all related hindrance, rescheduling, disruption, interference, inefficiency and productivity and production losses.

Department (DTMB)– Department of Technology, Management and Budget of the State of Michigan.

Director- The Director of the **Department**.

Director-SFA- The Director of **DTMB** State Facilities Administration.

Director-DCD- The Director of **DTMB** State Facilities Administration, Design and Construction Division.

Division– Each of the numbered, distinct parts (starting with Division 0) into which the Specifications are divided.

Drawings– Part of the Contract Documents showing the Work. Drawings must neither serve nor be used as Shop Drawings.

Emergency– A condition affecting the safety or protection of persons, or the Work, or property at or adjacent to the site.

State Facilities Administration (SFA)-Entity in the **Department** responsible for design, construction, and operations and maintenance of facilities.

Fee for the Work Involved (Fee)– An established, percentage mark-up on the Cost of the Work Involved which is allowed to the **Contractor** for (a) reasonable administrative costs, and (b) negotiated, reasonable profit on the Cost of the Work Involved.

Hazardous Material– Asbestos containing materials (ACMs), Polychlorinated biphenyls (PCBs), petroleum products, such construction materials as paint thinners, solvents, gasoline, oil, etc., and any other like material the manufacture, use, treatment, storage, transportation, or disposal of which is regulated by federal, state, or local Laws governing the protection of public health, natural resources, or the environment.

Invitation To Bid (ITB) - The solicitation document presenting the terms and conditions that will become part of the Contract when the Bid is accepted.

Law(s) - Means federal, state, and local statutes, ordinances, orders, rules and/or regulations.

MCL - The Michigan Compiled Laws of the State of Michigan.

Means and Methods - Includes means, methods, techniques, sequences and/or procedures applicable to the Work.

Notice of Award - Written notice accepting the Bid to the lowest responsive, responsible Bidder and designating the Contract Price (and establishing the Alternates accepted by the **Owner**).

Notice-to-Proceed - Written notice issued by the Project Director directing the Contractor to commence the construction activities and establishing the start date of the Contract Time.

On-Site Inspection - The **Professional's** on-site examination of the **Contractor's** completed or in progress Work to determine and verify to the Project Director that the quantity and quality of all Work complies with the requirements of the Contract Documents.

Owner - The State of Michigan, with whom the **Contractor** has entered into the Contract and for whom the Work is to be provided.

Owner Field Representative - A State employee or consultant, acting collaboratively with the Project Director, providing on-site, periodic observation and documentation of the Work for compliance with the Contract Documents.

Partial Use - The use, by the **Owner**, of a designated portion of the Work before accomplishing Substantial Completion of the entire Work. Partial Use does not mean Substantial Completion of the portion of the Work placed in use by the **Owner**.

Person - Individuals, partnerships, corporations, receivers, trustees, joint ventures or any other legal entity and any combinations of any of them.

Political Subdivision - Any county, city, village, or other local unit of the State, including any agency, department, or instrumentality of any such county, city, village, or other local unit.

Post-Bid Submittal - A Qualification Submittal required of the Bidder selected under Section 00100 - 22 before Contract Award, and which is used by the Owner in the evaluation of the Bid of the selected Bidder.

Professional Services Contractor (PSC or Professional) - The individual or business entity who has the authority to practice the design disciplines required by the Contract Documents. An Agency with appropriate licensing may replace the PSC in their role if a consultant is not used.

Project - The total construction, which includes the Work and possibly other work completed by others, as indicated in the Contract Documents.

Project Director - Designated State employee(s) (a) Responsible for directing and supervising the **Professional's** services during the period allowed for completion of the Work; and/or (b) Acting as representative for the **Owner** and for the enforcement of the Contract Documents, approving payment to the **Contractor** and coordinating the activities of the State, **Owner**, **Professional** and **Contractor**.

Project Schedule - Work Schedule that shows the **Contractor's** approach to planning, scheduling, and execution of the Work and that accurately portrays completed Work as to sequencing and timing, as provided in the Contract Documents.

Project Specifications - The Contract Documents organized into Divisions. "Technical Specifications" means Divisions of the Specifications consisting of technical descriptions of materials, equipment, construction systems, standards, and workmanship.

Provisionary Allowance - An amount included within the Contract Price to reimburse the **Contractor** for the cost to furnish and perform Work that is uncertain because, for example, it is indeterminate in scope and may not be shown or detailed in the Contract Documents.

Punch List - A list of minor items to be completed or corrected by the **Contractor**, any one of which do not materially impair the use of the Work for its intended purpose.

Qualified Disabled Veteran (QDV) - QDV as defined by Public Act 22 of 2010, MCL 18.1241.3 and supported by a DD214 Proof of Service and Discharge, a Veterans Administration rating decision letter, proof of disability (if the disability is not indicated on the DD214), and appropriate legal documents setting forth the 51% natural persons QDV ownership.

Record Documents– Drawings, Specifications, Addenda, Change Orders, Change Authorizations, Bulletins, inspection, test and approval reports, photographs, written clarifications and interpretations and all other documents recording, or annotated to show, all revisions and deviations between the as-built installation and the Contract Documents, all approved Submittals and all clarifications and interpretations.

Records– Books, reports, documents, electronic data, and other evidence relating to the bidding, award and furnishing and performance of the Work.

Recycled Material– Recycled paper products, structural materials made from recycled plastics, re-refined lubricating oils, reclaimed solvents, recycled asphalt and concrete, recycled glass products, re-treaded tires, ferrous metals containing recycled scrap metals and all other materials that contain (a) waste materials generated by a business or consumer, (b) materials that have served their intended purpose, and/or (c) materials that have been separated from solid waste for collection, recycling and disposition in the percentage determined by the State as provided by Law.

Request for Payment– The form provided by the **Owner** (Payment Request DTMB-0440) to be used by the **Contractor** in requesting payment for Work completed, which must enclose all supporting information required by the Contract Documents.

Schedule of Values– A schedule of pay items, which subdivides the Work into its various parts and which details, for each itemized part, cost and pricing information required for making payments for Work performed. The sum of all pay item costs in the Schedule of Values must equal the Contract Price for the Work.

Shop Drawings– Includes drawings, diagrams, illustrations, standard schedules, performance charts, instructions and other data prepared by or for the **Contractor** to illustrate some part of the Work, or by a Supplier and submitted by the **Contractor** to illustrate items of material or equipment.

Soil Erosion and Sedimentation Control– The planning, design and installation of appropriate Best Management Practices designed and engineered specifically to reduce or eliminate the off-site migration of soils via water runoff, wind, vehicle tracking, etc. Soil erosion and sedimentation control in the State of Michigan is regulated under The Natural Resources Environmental Protection Act; Soil Erosion and Sedimentation Control, 1994 PA 451, Part 91, as amended, MCL 324.9101 et seq. Soil erosion and sedimentation control associated with this Contract is monitored and enforced by the DTMB-SFA.

State– The State of Michigan in its governmental capacity, including its departments, divisions, agencies, boards, offices, commissions, officers, employees, and agents. Non-capitalized references to a state refer to a state other than the State of Michigan.

State Construction Code– The Michigan State Construction Code Act, 1972 PA 230, as amended, MCL 125.1501 et seq.

Subcontractor– A Person having an agreement with the Contractor to provide labor at the site and furnishing materials and/or equipment for incorporation into the Work.

Submittals– Includes technical Submittals, Progress Schedules and those other documents required for submission by the Contract Documents. The term "technical Submittal" includes Shop Drawings, brochures, samples, Operation and Maintenance (O&M) Manuals, test procedures and any other Submittal the Contract Documents require the **Contractor** to submit to demonstrate how the items covered, after installation or incorporation into the Work, will conform to the information given in the Contract Documents and be compatible with the design of the completed Work as a functioning whole as indicated in the Contract Documents.

Substantial Completion– The Work, or a portion of the Work designated in the Contract Documents as eligible for separate Substantial Completion, has been completed in accordance with the Contract Documents as determined by the PSC, to the extent that the **Owner** can use or occupy the entire Work, or the designated portion of the Work, for the use intended without any outstanding, concurrent Work at the site, except as may be required to complete or correct Punch List items.

Supplier– A manufacturer or fabricator, or a distributor, material man or vendor representing a manufacturer or fabricator, who has an agreement with the Contractor to furnish materials and/or equipment.

Underground Utilities– Pipelines, piping, conduit, duct, cables, wells, tanks, tunnels and appurtenances, or other similar facilities, installed underground to convey or support conveyance of potable water, sprinkler or irrigation water, fire protection systems, electricity, gases, steam, petroleum products, sewerage and drainage removal, telephone, communications, cable TV, traffic, or control systems.

Unit Price Work– The work involving specified quantities (i.e., related Work quantities) which, when performed, is measured by the **Professional** and paid using the measured quantities and unit prices contained in the Contract Documents. Performance of Unit Price Work for undefined quantities is contingent upon conditions encountered at the site, as determined, and authorized by the **Professional**.

Unit Price Work, Specific– Work of specified and defined quantities (i.e., quantities are detailed in, and can be taken-off from, the Contract Documents) that when performed is measured by the **Professional** and paid based on the measured quantities and unit prices contained in the Contract Documents.

Work- (as in “*the Work*,” “*the entire Work*”)– The entire *completed Construction* required by the Contract Documents. The Work results from furnishing and performing all services, obligations, responsibilities, management, supervision, labor, materials, equipment, construction equipment, general conditions, permits, taxes, patent fees and royalties, testing, inspection and approval responsibilities, warranties, temporary facilities, small tools, field supplies, Bonds, insurance, mobilization, close-out, overhead and all connections, devices and incidental items of any kind or nature required and/or made necessary by the Contract Documents.

Work Involved, any Work Involved– Existing or prospective Work (a) reflected in any notice, proposal, or claim, or (b) reflected in changes ordered or in process, or (c) affected by Delay.

APPENDIX II
SPECIAL WORKING CONDITIONS

DEPARTMENT OF MILITARY AND VETERANS AFFAIRS

The work comprising this Project will be performed at a National Guard Armory, and the contractor must comply with the following special working rules:

1. Contractor must submit a list of names, and additional information when requested on all persons expected to be employed on the Project site. Such list must be submitted directly to the Project Inspector or to his designee for approval before any person's appearance at the site for work assignments.
2. Contractor will be allowed to work within or on National Guard Armory confines from 7:45 a.m. to 4:30 p.m. No work may be performed on Saturdays or Sundays without written permission from the Project Inspector. The Armory Manager or their designee may arrange other time schedules.
3. All employees of the contractor may be subject to individual body search each time they enter the Armory. Packages or containers of any kind may be opened for inspection.
4. All employees of the contractor will be required to have identification cards or badges furnished by the contractor.
5. All trucks and other mobile equipment may be subject to inspection both on arrival and departure from the Armory.
6. Contractor must follow rules pertaining to security and parking as established by the Amory Manager. Contractor must observe all off-limit restricted areas beyond which no unauthorized personnel may trespass.
7. There will be no exchange, loaning, or borrowing of tools, equipment, or manpower between Armory personnel and the contractor.
8. The assigned gate through which materials, equipment, and vehicles must be transported will be opened upon request between 7:45 a.m. and 4:30 p.m.
9. Security personnel may be assigned to the working areas. They may inspect and search areas under construction at any time, including the contractor's equipment.
10. Areas for contractor's employee parking must be assigned only by the Armory Manager. Remove all firearms, weapons, alcoholic beverages, or explosives from vehicles before entering Armory property. Lock vehicles when not attended.
11. Keys to certain doors may be assigned to the contractor. Such doors must be kept locked at all times.
12. The Contractor shall furnish to the local authorities all necessary bonds or cash deposits required as a pledge and security for the protection or maintenance of any public property or as otherwise stipulated.
13. The Contractor's Superintendent or his duly authorized representative, shall remain in attendance at the Site and shall be present at all times when work of any kind is being done, including work done at other than normal working hours.
14. The Contractor's Superintendent shall not be removed except for valid cause acceptable to the Design Professional and the Owner in which case another Superintendent acceptable to them shall be provided.
15. Any employee of the Contractor whom the Design Professional or Owner considers detrimental to the proper carrying out of the Work is to be removed promptly on the request of the Design Professional.

All communications shall be in the form of written documents with the Design Professional or the DMVA Inspector. Verbal responses, instructions, approvals or permissions shall have no validity until supported by such documentation. Written response will be provided promptly, however, it may vary substantially from the verbal communication.

**ASBESTOS & LEAD BASED PAINT
BUILDING SURVEY**

Of

**The Detroit Light Guard Armory
4400 East 8 Mile Road
Detroit, MI 48234**

**Completed For:
The Michigan Department of
Military and Veterans Affairs**

By

**Asbestos Abatement, Inc.
2420 N. Grand River
Lansing, MI 48906**

**August 20, 2007
Project No. 070096**

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Asbestos & Lead Based Paint Building Survey
Detroit Light Guard
Project No. 070096
August 20, 2007

Introduction

The following Asbestos and Lead Based Paint Building Survey Report was completed for the Detroit Light Guard Armory which is located at 4400 East 8 Mile Road, Detroit, Michigan 48234. Survey work includes the main building (see attached drawing for survey areas). This survey was conducted to satisfy the requirements of the National Emissions Standard for Hazardous Air Pollutants (NESHAPS).

Asbestos Background

Asbestos is a naturally occurring mineral. It is distinguished from other minerals by the fact that its crystals form long, thin fibers. Deposits of asbestos are found throughout the world. The primary sites of commercial production are: Canada, China, Brazil, Zimbabwe, and South Africa asbestos is also mined commercially in limited quantities in the United States, in California and Vermont.

Asbestos minerals are divided into two groups—serpentines and amphiboles. The two groups are distinguished by their crystalline structure. Serpentine minerals have a sheet or layered structure, whereas amphiboles have a chain or spike-like shape. The table below describes six asbestos minerals that are members of these two groups.

Group	Mineral	Description and Properties
Serpentine	Chrysotile	<ul style="list-style-type: none"> • Green, gray, amber, or white fibers with a silky luster • very high in tensile strength. • Good electrical insulator under dry conditions. <p>Note: Chrysotile accounts for 95 percent of asbestos in buildings and commercial products.</p>
Amphibole	Amosite	<ul style="list-style-type: none"> • Gray, yellow, or dark brown fibers with a pearly luster course texture • low tensile strength <p>Note: amosite is the second most likely type of asbestos to be found in buildings..</p>
	Crocidolite	<ul style="list-style-type: none"> • Blue fibers with a silky or dull luster • Good acid resistance • Excellent thermal insulator
	Tremolite	<ul style="list-style-type: none"> • Gray-white, green, yellow, or blue fibers with a silky luster • Moderately high degree of hardness • Excellent acid and chemical resistance
	Actinolite	<ul style="list-style-type: none"> • Hard, green fibers with a silky luster • Harsh texture and poor flexibility • Low tensile strength
	Anthophyllite	<ul style="list-style-type: none"> • Yellow brown, gray, or white fibers with a harsh texture • Poor flexibility and low tensile strength • Good heat and acid resistance, and a good electrical insulator under humid conditions

Asbestos has been used in literally thousands of products. Collectively, these are referred to as asbestos-containing material (ACM). Asbestos gained wide-spread use because it was plentiful,

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readily available, and low in cost. Because of its unique properties – fire resistance, high tensile strength, poor heat and electrical conductivity, and being generally impervious to chemicals attacks – asbestos proved well-suited for many uses in the construction trades.

Asbestos-related diseases are chronic diseases, and symptoms usually do not appear for 15 to 40 years after initial exposures to airborne asbestos fibers. In nearly all cases, many years of exposure to high levels of airborne ACM is necessary for personnel to contract asbestos-related diseases.

The primary exposure route is inhalation. Inhaled fibers may become embedded in the bronchial tubes or alveoli, or they may pass through to the pleura—the lining of the chest cavity. Asbestos-related diseases include asbestosis, lung cancer, mesothelioma, and gastrointestinal cancers.

Survey Procedures

Survey work was conducted by Mr. John Rehkopf of Northern Analytical Services, LLC. Mr. Rehkopf is a properly trained and accredited State of Michigan Asbestos Building Inspector (accreditation A16809).

To complete this survey, the Mr. Rehkopf reviewed available drawings, previous building inspection reports, and interviewed site personnel to determine building perimeters and construction/renovation dates. Once this information was obtained, Mr. Rehkopf began a detailed survey of the areas indicated on the attached drawing for the presence of suspect asbestos containing materials (ACM). Individual homogeneous rooms were identified and assigned a unique room number.

At the time this Survey was conducted, the Inspector had to assume all suspect ACM contained asbestos; because of this, selective interior demolition was prohibited. The inspector made every attempt to locate and investigate wall and ceiling cavities, however it is assumed that there are remaining unknown cavities within the building. Further investigation must be conducted by properly trained and accredited personnel prior to or during any demolition or renovation activities taking place to determine the presence of ACM.

Once identified, each suspect ACM was assigned a unique identifying number, called a Homogeneous Material Number, and provided a written description, called a Homogeneous Material Description. Each Homogeneous Material was then categorized as thermal, surfacing, or miscellaneous; then quantified and classified as either friable or not friable. Please keep in mind that materials classified as not friable at the time of the survey may become friable overtime or during renovation activities. A few of the suspect ACM found in this building include drywall, floor tile, fire doors, pipe insulation, and ceiling tiles.

Identified suspect ACM were then either sampled for the presence of asbestos or assumed to contain asbestos. The Inspector made every attempt to collect samples from each identified suspect ACM, however in some cases sample collection was not feasible. An example of this

would be fire doors, in order to sample a fire door a whole must be drilled into the core of the door thus permanently damaging the door and potentially causing a fiber release.

Samples from each remaining suspect materials were collected in random locations. A unique Sample No. was assigned to each sample collected to link it to the corresponding material. Sample numbers begin with the materials Homogeneous Material No., and then two figures starting with 01 were added to the end. For example, sample number 301 was collected from material number 3, which is Mud Compound Fitting Insulation. If additional samples were collected from the same material, sample numbers increased consecutively, therefore sample numbers 301, 302, 303 would all be from Material No. 3.

The number of samples collected from each material was determined by regulatory requirements and the Inspector's findings. Regulatory requirements for each of the three material classifications are as follows:

- Friable Surfacing Materials require either 3, 5, or 7 samples depending on the amount of material present. (3 for <1,000 sq.ft., 5 for 1,000 to 5,000 sq.ft., and 7 for >5,000 sq.ft.)
- Thermal system insulation requires a minimum of 3 samples
- Miscellaneous and not friable materials require a minimum of 1 sample.

Once collected, samples were properly packaged and shipped via Federal Express to an independent, properly accredited laboratory for analysis. Analytical results have been included at the end of the Survey Data Section for each building.

Findings

Asbestos

During the survey process 23 suspect asbestos containing materials were identified. Four of these suspect materials were identified through laboratory analysis to contain asbestos and 7 were assumed to contain asbestos. The attached Homogenous Material Reports provides more detail on each of the 23 suspect asbestos containing materials and their asbestos content. The attached section titled Survey Reports provides a room by room detail of the homogeneous materials identified as suspect ACM and their asbestos content.

Please note on the attached drawing that several areas, indicated with hatch markings, were not accessed during the survey and subsequently were not inspected. It is recommended that these areas be inspected prior to any renovation activities. Please keep in mind that the materials present in these areas may appear similar to those identified in other areas as listed in this report, however only a licensed asbestos building inspector can make that determination. In addition most of the building contains a plaster ceiling of some type, the areas directly above these ceilings was not accessible and also not inspected.

Lead Based Paint

The current primary color used in the building is white, however during sample collection it was evident that previous colors were used. Two different paint samples were sampled with results as follows:

<u>Sample No.</u>	<u>Color</u>	<u>Location</u>	<u>Results</u>
101	White	136 on concrete pillar near north west corner	0.84%
201	White	012 on wall near north west corner	0.11%

Recommendations

Based on the findings of the Inspector, the following site recommendations have been made:

- Have the areas not included on the attached drawing properly inspected by a licensed inspector.
- Contract an accredited Asbestos Project Designer to complete an abatement design prior to conducting abatement activities.
- Contract a licensed abatement contractor to properly remove ACM that will likely be disturbed during upcoming renovation activities.
- Provide at a minimum 2 hours of asbestos Awareness Training to all maintenance/custodial staff assigned to the main building. Training should be site specific.
- It is recommended that any asbestos abatement activities be monitored by a third party asbestos consultant.
- Periodically re-inspect and assess the condition of materials that are either known or assumed to contain asbestos. Should a material become damaged, have it properly repaired or removed by a licensed abatement contractor. Please keep in mind that materials that are classified as not friable at the time of the survey, may become friable overtime or during renovation activities.
- Should a material be discovered that does not clearly match the materials identified in this report, contact Asbestos Abatement, Inc. to have the material properly tested for asbestos.
- Treat all painted surfaces as lead containing. Demolition or renovation activities should be conducted by properly trained personnel only.

Homogeneous Material Report

Homogeneous Material Report

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<i>Material No.</i>	<i>Homogeneous Material Description</i>	<i>Category</i>	<i>Friability</i>	<i>Asbestos Detected</i>	<i>Percent Asbestos</i>	<i>Asbestos Type</i>	<i>Quantity</i>	<i>Units</i>
1	Fire Doors & Frames	Miscellaneous	Not Friable	Assumed	---	---	97	Sq.Ft.
3	Mud Elbows, Fittings & Hangers	Thermal	Friable	Yes	10%	Chrysotile	2895	Each
4	Mag Pipe Insulation	Thermal	Friable	Yes	10% 20%	Chrysotile Amosite	14267	Ln.Ft.
5	Assumed ACM Flooring Under Carpet	Miscellaneous	Not Friable	Assumed	---	---	4890	Sq.Ft.
6	Plaster	Surfacing	Not Friable	No	---	---	33288	Sq.Ft.
7	Black Mastic Under Wood Floor	Miscellaneous	Not Friable	Yes	4%	Chrysotile	29589	Sq.Ft.
8	4'x4' Ceiling Tile, White w/ Random Pinholes	Miscellaneous	Friable	No	---	---	29589	Sq.Ft.
9	Transite Window Blanks (wrapped with aluminum)	Miscellaneous	Not Friable	Assumed	---	---	5800	Sq.Ft.
10	Assumed Pipe Insulation in Walls or Ceiling Cavity	Thermal	Friable	Assumed	---	---	1585	Ln.Ft.
11	Wood Paneling Glue	Miscellaneous	Not Friable	No	---	---	418	Sq.Ft.
13	9x9 Floor Tile & Mastic, Tan w/ White Streaks	Miscellaneous	Not Friable	Assumed	---	---	2004	Sq.Ft.
14	4" Brown Cove Base & Mastic	Miscellaneous	Not Friable	No	---	---	870	Ln.Ft.
15	2x4 Ceiling Tile, White w/ Random Pinholes	Miscellaneous	Friable	No	---	---	4382	Sq.Ft.
16	Spray on Acoustical Ceiling	Surfacing	Friable	Yes	5%	Chrysotile	12201	Sq.Ft.

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<i>Material No.</i>	<i>Homogeneous Material Description</i>	<i>Catagory</i>	<i>Friability</i>	<i>Asbestos Detected</i>	<i>Percent Asbestos</i>	<i>Asbestos Type</i>	<i>Quantity</i>	<i>Units</i>
17	12x12 Floor Tile & Mastic, Brown	Miscellaneous	Not Friable	No	---	---	1124	Sq.Ft.
18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	Miscellaneous	Not Friable	No	---	---	7690	Sq.Ft.
19	Drywall & Joint Compound	Miscellaneous	Not Friable	No	---	---	322	Sq.Ft.
20	12x12 Floor Tile & Mastic, White w/ Grey Flex	Miscellaneous	Not Friable	No	---	---	947	Sq.Ft.
21	Fiberglass Duct Wrap w/ Mudded Seams	Thermal	Friable	Assumed	---	---	200	Sq.Ft.
22	12x12 Floor Tile & Mastic, White w/ Black & Grey Streaks	Miscellaneous	Not Friable	No	---	---	3860	Sq.Ft.
23	12x12 Floor Tile & Mastic, Green w/ White Flex	Miscellaneous	Not Friable	No	---	---	4454	Sq.Ft.
24	12x12 Ceiling Tile, White w/ Fine Texture Pattern	Surfacing	Not Friable	No	---	---	3309	Sq.Ft.
25	ACM Pipe Insulation Debris in Soil	Thermal	Friable	Assumed	---	---	12346	Sq.Ft.

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01	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
010	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	280	Each	
010	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	1250	Ln.Ft.	
011	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	298	Each	
011	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	1280	Ln.Ft.	
012	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	48	Each	
012	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	330	Ln.Ft.	
013	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	12	Each	
013	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	65	Ln.Ft.	
017	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	312	Sq.Ft.	
017	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	18	Each	
017	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	46	Ln.Ft.	
018	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	30	Ln.Ft.	

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018	6	Plaster	No	---	105	Sq.Ft.	No Access Above Ceiling- Not Inspected
019	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	15	Ln.Ft.	
02	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	180	Ln.Ft.	
02	1	Fire Doors & Frames	Assumed	---	4	Sq.Ft.	
02	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	25	Each	
020	6	Plaster	No	---	150	Sq.Ft.	No Access Above Ceiling- Not Inspected
020	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	30	Ln.Ft.	
020	6	Plaster	No	---	15	Sq.Ft.	No Access Above Ceiling- Not Inspected
021	24	12x12 Ceing Tile, White w/ Fine Texture Pattern	No	---	3309	Sq.Ft.	
021	23	12x12 Floor Tile & Mastic, Green w/ White Flex	No	---	3309	Sq.Ft.	
022	23	12x12 Floor Tile & Mastic, Green w/ White Flex	No	---	180	Sq.Ft.	
023	15	2x4 Ceiling Tile, White w/ Random Pinholes	No	---	754	Sq.Ft.	
023	23	12x12 Floor Tile & Mastic, Green w/ White Flex	No	---	754	Sq.Ft.	

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023	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	48	Each	Above Ceiling
023	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	200	Ln.Ft.	Above Ceiling
024	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	1190	Ln.Ft.	
024	25	ACM Pipe Insulation Debris in Soil	Assumed	---	12346	Sq.Ft.	Entire Soil Area to a min. depth of 4"
024	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	337	Each	
025	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	18	Each	
025	23	12x12 Floor Tile & Mastic, Green w/ White Flex	No	---	211	Sq.Ft.	
025	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	60	Ln.Ft.	
025	6	Plaster	No	---	211	Sq.Ft.	No Access Above Ceiling- Not Inspected
027	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	780	Ln.Ft.	
027	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	90	Each	
027	1	Fire Doors & Frames	Assumed	---	3	Sq.Ft.	
029	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	

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03	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	180	Each	
03	1	Fire Doors & Frames	Assumed	---	4	Sq.Ft.	
03	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	1980	Ln.Ft.	
030	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	8	Ln.Ft.	
030	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	9	Each	
04	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	260	Each	
04	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	1800	Ln.Ft.	
05	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	38	Each	
05	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	160	Ln.Ft.	
050	23	12x12 Floor Tile & Mastic, Green w/ White Flex	No	---		Sq.Ft.	
050	24	12x12 Ceiling Tile, White w/ Fine Texture Pattern	No	---		Sq.Ft.	
050	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	6	Each	
06	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	145	Ln.Ft.	

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06	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	620	Each	
07	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
07	19	Drywall & Joint Compound	No	---	322	Sq.Ft.	
08	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	120	Ln.Ft.	
08	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
08	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	23	Each	
09	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	
09	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	15	Each	
09	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	30	Ln.Ft.	
10	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
10	6	Plaster	No	---	14	Sq.Ft.	
10	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	10	Ln.Ft.	
10	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	36	Sq.Ft.	

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11	1	Fire Doors & Frames	Assumed	---	3	Sq.Ft.	
11	6	Plaster	No	---	115	Sq.Ft.	No Access Above Ceiling- Not Inspected
11	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling
11	14	4" Brown Cove Base & Mastic	No	---	40	Ln.Ft.	
11	20	12x12 Floor Tile & Mastic, White w/ Grey Flex	No	---	115	Sq.Ft.	
11	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	115	Sq.Ft.	Under HA No. 20
117	6	Plaster	No	---	1413	Sq.Ft.	No Access Above Ceiling- Not Inspected
117	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	8	Each	
117	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	12	Ln.Ft.	
123	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	606	Sq.Ft.	
123	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	4	Each	
123	6	Plaster	No	---	606	Sq.Ft.	No Access Above Ceiling- Not Inspected
123	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	6	Ln.Ft.	

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127	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	12	Each	
127	6	Plaster	No	---	1869	Sq.Ft.	No Access Above Ceiling- Not Inspected
127	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	38	Ln.Ft.	
13	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	150	Sq.Ft.	
13	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	432	Sq.Ft.	Under Carpet
13	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	
13	6	Plaster	No	---	432	Sq.Ft.	No Access Above Ceiling- Not Inspected
13	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	120	Ln.Ft.	
134	6	Plaster	No	---	600	Sq.Ft.	No Access Above Ceiling- Not Inspected
135	6	Plaster	No	---	600	Sq.Ft.	No Access Above Ceiling- Not Inspected
136	6	Plaster	No	---	988	Sq.Ft.	No Access Above Ceiling- Not Inspected
136	14	4" Brown Cove Base & Mastic	No	---	260	Ln.Ft.	
136	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	30	Each	Above Ceiling

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136	15	2x4 Ceiling Tile, White w/ Random Pinholes	No	---	655	Sq.Ft.	No Access Above Ceiling- Not Inspected
136	13	9x9 Floor Tile & Mastic, Tan w/ White Streaks	Assumed	---	988	Sq.Ft.	
136	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	350	Ln.Ft.	Above Ceiling
137	15	2x4 Ceiling Tile, White w/ Random Pinholes	No	---	2140	Sq.Ft.	No Access Above Ceiling- Not Inspected
137	10	Assumed Pipe Insulation in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	
137	13	9x9 Floor Tile & Mastic, Tan w/ White Streaks	Assumed	---	1016	Sq.Ft.	
137	19	Drywall & Joint Compound	No	---		Sq.Ft.	Not Quantified
137	14	4" Brown Cove Base & Mastic	No	---	220	Ln.Ft.	
137	17	12x12 Floor Tile & Mastic, Brown	No	---	1124	Sq.Ft.	
137	9	Transite Window Blanks (wrapped with aluminum)	Assumed	---	240	Sq.Ft.	
137	16	Spray on Acoustical Ceiling	Yes	Chrysotile	2140	Sq.Ft.	No Access Above Ceiling- Not Inspected
138	9	Transite Window Blanks (wrapped with aluminum)	Assumed	---	180	Sq.Ft.	
138	16	Spray on Acoustical Ceiling	Yes	Chrysotile	1120	Sq.Ft.	No Access Above Ceiling- Not Inspected

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138	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	
138	5	Assumed ACM Flooring Under Carpet	Assumed	---	1120	Sq.Ft.	
139	16	Spray on Accoustical Ceiling	Yes	Chrysotile	3705	Sq.Ft.	No Access Above Ceiling- Not Inspected
139	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	900	Sq.Ft.	
139	1	Fire Doors & Frames	Assumed	---	11	Sq.Ft.	
139	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	
140	20	12x12 Floor Tile & Mastic, White w/ Grey Flex	No	---	832	Sq.Ft.	
140	16	Spray on Accoustical Ceiling	Yes	Chrysotile	833	Sq.Ft.	No Access Above Ceiling- Not Inspected
140	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	832	Sq.Ft.	Under HA No. 20
140	14	4" Brown Cove Base & Mastic	No	---	300	Ln.Ft.	
140	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	86	Each	Above Ceiling
140	15	2x4 Ceiling Tile, White w/ Random Pinholes	No	---	833	Sq.Ft.	
140	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	398	Ln.Ft.	Above Ceiling

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141	1	Fire Doors & Frames	Assumed	---	3	Sq.Ft.	5
141	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	3	Each	
141	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	4	Ln.Ft.	
141	6	Plaster	No	---	160	Sq.Ft.	No Access Above Ceiling- Not Inspected
141	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	50	Sq.Ft.	
142	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	3	Each	
142	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	10	Ln.Ft.	
142	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	543	Sq.Ft.	
142	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling
142	16	Spray on Accoustical Ceiling	Yes	Chrysotile	543	Sq.Ft.	No Access Above Ceiling- Not Inspected
143	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
143	6	Plaster	No	---	1400	Sq.Ft.	No Access Above Ceiling- Not Inspected
143	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	80	Ln.Ft.	

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<i>Room No.</i>	<i>Material No.</i>	<i>Homogeneous Material Description</i>	<i>Asbestos Detected</i>	<i>Asbestos Type</i>	<i>Quantity</i>	<i>units</i>	<i>Comments</i>
143	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	12	Each	
144	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	314	Sq.Ft.	Mastic Under Ceramic Tile
144	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	50	Sq.Ft.	
144	6	Plaster	No	---	314	Sq.Ft.	No Access Above Ceiling- Not Inspected
146	6	Plaster	No	---	314	Sq.Ft.	No Access Above Ceiling- Not Inspected
147	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
15	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	
15	6	Plaster	No	---	200	Sq.Ft.	No Access Above Ceiling- Not Inspected
15	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Above Ceiling
15	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	50	Sq.Ft.	
15	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	200	Sq.Ft.	Under Carpet
150	6	Plaster	No	---	300	Sq.Ft.	No Access Above Ceiling- Not Inspected
150	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	12	Each	

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150	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	48	Ln.Ft.	
151	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	60	Ln.Ft.	
151	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	18	Each	
151	6	Plaster	No	---	340	Sq.Ft.	No Access Above Ceiling- Not Inspected
152	6	Plaster	No	---	928	Sq.Ft.	No Access Above Ceiling- Not Inspected
152	1	Fire Doors & Frames	Assumed	---	6	Sq.Ft.	
152	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	72	Sq.Ft.	
160	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Above Ceiling
160	5	Assumed ACM Flooring Under Carpet	Assumed	---	710	Sq.Ft.	
160	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
160	6	Plaster	No	---	710	Sq.Ft.	No Access Above Ceiling- Not Inspected
161	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
161	6	Plaster	No	---	1500	Sq.Ft.	No Access Above Ceiling- Not Inspected

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161	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	60	Ln.Ft.	
161	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	12	Each	
162	6	Plaster	No	---	269	Sq.Ft.	No Access Above Ceiling- Not Inspected
162	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	12	Ln.Ft.	
162	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	269	Sq.Ft.	
162	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
162	6	Plaster	No	---	335	Sq.Ft.	No Access Above Ceiling- Not Inspected
162	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	4	Each	
163	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
164	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
165	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
166	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	
166	6	Plaster	No	---	600	Sq.Ft.	No Access Above Ceiling- Not Inspected

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167	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
167	6	Plaster	No	---	600	Sq.Ft.	No Access Above Ceiling- Not Inspected
168	5	Assumed ACM Flooring Under Carpet	Assumed	---	387	Sq.Ft.	
168	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	12	Each	
168	6	Plaster	No	---	387	Sq.Ft.	No Access Above Ceiling- Not Inspected
168	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	48	Ln.Ft.	
169	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	6	Each	
169	6	Plaster	No	---	152	Sq.Ft.	No Access Above Ceiling- Not Inspected
169	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	12	Ln.Ft.	
170	6	Plaster	No	---	152	Sq.Ft.	No Access Above Ceiling- Not Inspected
171	6	Plaster	No	---	120	Sq.Ft.	No Access Above Ceiling- Not Inspected
172	6	Plaster	No	---	200	Sq.Ft.	No Access Above Ceiling- Not Inspected
173	6	Plaster	No	---	470	Sq.Ft.	No Access Above Ceiling- Not Inspected

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173	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	6	Each	
173	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	12	Ln.Ft.	
173	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	470	Sq.Ft.	
174	6	Plaster	No	---	540	Sq.Ft.	No Access Above Ceiling- Not Inspected
174	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	Safe Door
179	6	Plaster	No	---	640	Sq.Ft.	No Access Above Ceiling- Not Inspected
179	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	20	Each	Assumed in Walls & Above Ceiling
179	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	80	Ln.Ft.	Assumed in Walls & Above Ceiling
201	16	Spray on Accoustical Ceiling	Yes	Chrysotile	3860	Sq.Ft.	No Access Above Ceiling- Not Inspected
201	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	2	Each	
201	22	12x12 Floor Tile & Mastic, White w/ Black & Grey Streaks	No	---	3860	Sq.Ft.	
201	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	500	Sq.Ft.	
202	6	Plaster	No	---	560	Sq.Ft.	No Access Above Ceiling- Not Inspected

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202	1	Fire Doors & Frames	Assumed	---	3	Sq.Ft.	
202	9	Transite Window Blanks (wrapped with aluminum)	Assumed	---	75	Sq.Ft.	
203	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	120	Each	
203	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	2180	Ln.Ft.	over 22' above floor
21	6	Plaster	No	---	200	Sq.Ft.	No Access Above Ceiling- Not Inspected
21	9	Transite Window Blanks (wrapped with aluminum)	Assumed	---	50	Sq.Ft.	
21	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling
21	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
21	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	200	Sq.Ft.	Under Carpet
23	6	Plaster	No	---	140	Sq.Ft.	No Access Above Ceiling-Not Inspected
23	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
23	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	140	Sq.Ft.	Under Carpet
23	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling

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23	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	20	Ln.Ft.	
24	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
24	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling
24	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
24	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	100	Sq.Ft.	
24	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	100	Sq.Ft.	Under Carpet
28	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	80	Ln.Ft.	Assumed Above Ceiling
28	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	200	Sq.Ft.	
28	6	Plaster	No	---	689	Sq.Ft.	No Access Above Ceiling- Not Inspected
28	1	Fire Doors & Frames	Assumed	---	4	Sq.Ft.	
29	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling
29	5	Assumed ACM Flooring Under Carpet	Assumed	---	232	Sq.Ft.	
29	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	100	Sq.Ft.	

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29	1	Fire Doors & Frames	Assumed	---	3	Sq.Ft.	
29	6	Plaster	No	---	232	Sq.Ft.	No Access Above Ceiling- Not Inspected
31	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	10	Each	Assumed Above Ceiling
31	6	Plaster	No	---	568	Sq.Ft.	No Access Above Ceiling- Not Inspected
31	1	Fire Doors & Frames	Assumed	---	3	Sq.Ft.	
31	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	50	Ln.Ft.	Assumed Above Ceiling
31	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	568	Sq.Ft.	Under Carpet
31	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	150	Sq.Ft.	
33	6	Plaster	No	---	541	Sq.Ft.	No Access Above Ceiling- Not Inspected
33	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	541	Sq.Ft.	Under Carpet
33	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	100	Sq.Ft.	
33	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
33	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	100	Sq.Ft.	

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35	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	100	Sq.Ft.	
35	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
35	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	541	Sq.Ft.	Under Carpet
35	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling-No Access
35	6	Plaster	No	---	541	Sq.Ft.	No Access Above Ceiling-Not Inspected
37	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	48	Sq.Ft.	
37	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling-No Access
37	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	160	Sq.Ft.	Under Carpet
37	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	
37	6	Plaster	No	---	160	Sq.Ft.	No Access Above Ceiling-Not Inspected
38	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
38	6	Plaster	No	---	309	Sq.Ft.	No Access Above Ceiling-Not Inspected
38	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	309	Sq.Ft.	

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38	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling-No Access
38	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	48	Sq.Ft.	
40	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
40	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	48	Sq.Ft.	
40	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling-No Access
40	6	Plaster	No	---	202	Sq.Ft.	No Access Above Ceiling-Not Inspected
40	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	202	Sq.Ft.	Under Carpet
43	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	247	Sq.Ft.	Under Carpet
43	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Assumed Above Ceiling-No Access
43	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
43	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	148	Sq.Ft.	
43	6	Plaster	No	---	247	Sq.Ft.	No Access Above Ceiling-Not Inspected
5	6	Plaster	No	---	315	Sq.Ft.	No Access Above Ceiling-Not Inspected

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5	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	30	Each	Assumed in Walls & Above Ceiling
5	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	200	Ln.Ft.	Assumed in Walls & Above Ceiling
53	6	Plaster	No	---	311	Sq.Ft.	No Access Above Ceiling- Not Inspected
53	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	60	Ln.Ft.	Above Ceiling
53	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	45	Sq.Ft.	
53	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	4	Each	
53	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	3	Ln.Ft.	
53	1	Fire Doors & Frames	Assumed	---	7	Sq.Ft.	
54	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	160	Ln.Ft.	
54	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	
54	6	Plaster	No	---	686	Sq.Ft.	No Access Above Ceiling- Not Inspected
54	5	Assumed ACM Flooring Under Carpet	Assumed	---	686	Sq.Ft.	
54	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	31	Each	

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56	7	Black Mastic Under Wood Floor	Yes	Chrysotile	29589	Sq.Ft.	
56	8	4'x4' Ceiling Tile, White w/ Random Pinholes	No	---	29589	Sq.Ft.	
56	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	2200	Sq.Ft.	11 units x 200 sq.ft. each
58	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	12	Ln.Ft.	
58	6	Plaster	No	---	20	Sq.Ft.	No Access Above Ceiling- Not Inspected
59	6	Plaster	No	---	246	Sq.Ft.	No Access Above Ceiling- Not Inspected
59	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	190	Ln.Ft.	
59	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	25	Each	
59	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
6	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	150	Sq.Ft.	
6	14	4" Brown Cove Base & Mastic	No	---	50	Ln.Ft.	
6	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	200	Ln.Ft.	Assumed in Walls & Above Ceiling
6	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	30	Each	Assumed in Walls & Above Ceiling

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6	6	Plaster	No	---	530	Sq.Ft.	No Access Above Ceiling- Not Inspected
60	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	6	Ln.Ft.	
60	6	Plaster	No	---	600	Sq.Ft.	No Access Above Ceiling- Not Inspected
60	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	200	Ln.Ft.	
60	5	Assumed ACM Flooring Under Carpet	Assumed	---	12	Sq.Ft.	
61	5	Assumed ACM Flooring Under Carpet	Assumed	---	750	Sq.Ft.	Half of room
61	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	30	Ln.Ft.	
61	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	4	Each	
61	6	Plaster	No	---	1310	Sq.Ft.	No Access Above Ceiling- Not Inspected
62	6	Plaster	No	---	309	Sq.Ft.	No Access Above Ceiling- Not Inspected
62	5	Assumed ACM Flooring Under Carpet	Assumed	---	309	Sq.Ft.	
63	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	10	Ln.Ft.	
63	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	6	Each	

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63	11	Wood Paneling Glue	No	---	380	Sq.Ft.	
63	5	Assumed ACM Flooring Under Carpet	Assumed	---	80	Sq.Ft.	
63	6	Plaster	No	---	71	Sq.Ft.	No Access Above Ceiling- Not Inspected
64	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	6	Each	
64	11	Wood Paneling Glue	No	---	38	Sq.Ft.	
64	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	10	Ln.Ft.	
64	5	Assumed ACM Flooring Under Carpet	Assumed	---	80	Sq.Ft.	
64	6	Plaster	No	---	71	Sq.Ft.	No Access Above Ceiling- Not Inspected
65	6	Plaster	No	---	140	Sq.Ft.	No Access Above Ceiling- Not Inspected
66	6	Plaster	No	---	81	Sq.Ft.	No Access Above Ceiling- Not Inspected
67	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
68	6	Plaster	No	---	327	Sq.Ft.	No Access Above Ceiling- Not Inspected
68	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	

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69	6	Plaster	No	---	624	Sq.Ft.	No Access Above Ceiling- Not Inspete
69	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	14	Ln.Ft.	
69	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	6	Each	
69	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	
70	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	12	Ln.Ft.	
70	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	48	Sq.Ft.	
70	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	4	Each	
70	6	Plaster	No	---	316	Sq.Ft.	No Access Above Ceiling- Not Inspected
71	6	Plaster	No	---	303	Sq.Ft.	No Access Above Ceiling- Not Inspected
71	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	No	---	303	Sq.Ft.	
71	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	48	Sq.Ft.	
72	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
73	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected

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<i>Room No.</i>	<i>Material No.</i>	<i>Homogeneous Material Description</i>	<i>Asbestos Detected</i>	<i>Asbestos Type</i>	<i>Quantity</i>	<i>units</i>	<i>Comments</i>
74	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
76	6	Plaster	No	---	1468	Sq.Ft.	No Access Above Ceiling- Not Inspected
76	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
76	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	18	Each	
76	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	103	Ln.Ft.	
77	1	Fire Doors & Frames	Assumed	---	2	Sq.Ft.	
77	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
77	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	66	Ln.Ft.	
77	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	4	Each	
77.1	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
78	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	50	Sq.Ft.	
78	6	Plaster	No	---	217	Sq.Ft.	No Access Above Ceiling- Not Inspected
78	5	Assumed ACM Flooring Under Carpet	Assumed	---	217	Sq.Ft.	

Survey Report

Project No 070096
 Detroit Light Guard
 4400 E 8 Mile Rd
 Detroit, MI 48234

<i>Room No.</i>	<i>Material No.</i>	<i>Homogeneous Material Description</i>	<i>Asbestos Detected</i>	<i>Asbestos Type</i>	<i>Quantity</i>	<i>units</i>	<i>Comments</i>
79	6	Plaster	No	---	53	Sq.Ft.	No Access Above Ceiling- Not Inspected
81	6	Plaster	No	---	53	Sq.Ft.	No Access Above Ceiling- Not Inspected
83	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	95	Ln.Ft.	
83	6	Plaster	No	---	1477	Sq.Ft.	No Access Above Ceiling- Not Inspected
83	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	
83	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	8	Each	
84	5	Assumed ACM Flooring Under Carpet	Assumed	---	307	Sq.Ft.	
84	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	22	Ln.Ft.	
84	9	Transite Window Blanks (wrapped with alluminum)	Assumed	---	50	Sq.Ft.	
84	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	8	Each	
84	6	Plaster	No	---	307	Sq.Ft.	No Access Above Ceiling- Not Inspected
85	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
85	21	Fiberglass Duct Wrap w/ Mudded Seams	Assumed	---	200	Sq.Ft.	

Survey Report

Project No 070096
 Detroit Light Guard
 4400 E 8 Mile Rd
 Detroit, MI 48234

<i>Room No.</i>	<i>Material No.</i>	<i>Homogeneous Material Description</i>	<i>Asbestos Detected</i>	<i>Asbestos Type</i>	<i>Quantity</i>	<i>units</i>	<i>Comments</i>
86	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
86	4	Mag Pipe Insulation	Yes	Chrysotile Amosite	30	Ln.Ft.	
86	3	Mud Elbows, Fittings & Hangers	Yes	Chrysotile	6	Each	
87	6	Plaster	No	---	100	Sq.Ft.	No Access Above Ceiling- Not Inspected
9	10	Assumed Pipe Insultion in Walls or Ceiling Cavity	Assumed	---	80	Ln.Ft.	
9	6	Plaster	No	---	115	Sq.Ft.	No Access Above Ceiling- Not Inspected
9	1	Fire Doors & Frames	Assumed	---	1	Sq.Ft.	

Sample Location Report

Sample Location Report

Project No 070096
Detroit Light Guard
4400 E 8 Mile Rd
Detroit, MI 48234

Sample Number	Material No.	Homogenous Material Description	Room No.	Sample Location
301	3	Mud Elbows, Fittings & Hangers	54	North East Corner
401	4	Mag Pipe Insulation	54	North East Corner
601	6	Plaster	163	Center of Ceiling at Damage
601	6	Plaster	152	North East Corner
603	6	Plaster	40	North West Corner
701	7	Black Mastic Under Wood Floor	56	33' North, 1' East of South West Corner
801	8	4'x4' Ceiling Tile, White w/ Random Pinholes	203	At Stairway Opening to Attic
1101	11	Wood Paneling Glue	63	Next to Window near South West Corner
1301	13	9x9 Floor Tile & Mastic, Tan w/ White Streaks	137	38' East of South West Corner
1401	14	4" Brown Cove Base & Mastic	137	36'-6" East of South West Corner
1501	15	2x4 Ceiling Tile, White w/ Random Pinholes	137	22' East of South West Corner
1601	16	Spray on Accoustical Ceilng	137	22' East of South West Corner Above Ceiling Tile
1602	16	Spray on Accoustical Ceilng	201	28' East of North West Corner Next to Soffit
1701	17	12x12 Floor Tile & Mastic, Brown	137	42 ' East of South West Corner
1801	18	9x9 Floor Tile & Mastic, Brown w/ White Streaks	10	At Doorway

Sample Location Report

Project No 070096
Detroit Light Guard
4400 E 8 Mile Rd
Detroit, MI 48234

Sample Number	Material No.	Homogenous Material Description	Room No.	Sample Location
1901	19	Drywall & Joint Compound	201	28' East of North West Corner on Soffit
2001	20	12x12 Floor Tile & Mastic, White w/ Grey Flex	10	At Doorway
2201	22	12x12 Floor Tile & Mastic, White w/ Black & Grey Streaks	201	Next to Doorway
2301	23	12x12 Floor Tile & Mastic, Green w/ White Flex	022	Next to Doorway
2401	24	12x12 Ceiling Tile, White w/ Fine Texture Pattern	021	61' West of South East Corner

Laboratory Analysis



EMSL Analytical, Inc.

212 South Wagner Road, Ann Arbor, MI 48103

Phone: (734) 668-6810 Fax: (734) 668-8532 Email: annarborlab@emsl.com

Attn: **John Rehkopf**
Northern Analytical Services
21391 13 Mile Rd
Leroy, MI 49655

Customer ID: NOAN22
Customer PO:
Received: 08/16/07 10:30 AM
EMSL Order: 080702748
EMSL Proj:
Analysis Date: 8/17/2007
Report Date: 8/17/2007


Fax: (866) 214-4739 Phone: (231) 679-0005
Project: **Detroit Light Guard**

Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Location	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
301 080702748-0001		White Fibrous Heterogeneous	2% Cellulose 20% Glass	68% Non-fibrous (other)	10% Chrysotile
401 080702748-0002		White Fibrous Heterogeneous		70% Non-fibrous (other)	20% Amosite 10% Chrysotile
601 080702748-0003	Brown Coat	Gray Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
601A 080702748-0003A	Finish Coat	White Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
602 080702748-0004	Finish Coat Only	White Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
603 080702748-0005	Finish Coat Only	White Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
701 080702748-0006		Black Non-Fibrous Heterogeneous	3% Cellulose	93% Non-fibrous (other)	4% Chrysotile
801 080702748-0007		White Fibrous Heterogeneous	40% Cellulose 40% Glass	20% Non-fibrous (other)	None Detected

Analyst(s)

Justin Bolton (15)
Todd Miller (15)



or other approved signatory

Due to magnification limitations inherent in PLM, asbestos fibers in dimensions below the resolution capability of PLM may not be detected. Samples reported as <1% or none detected may require additional testing by TEM to confirm asbestos quantities. The limit of detection as stated in the method is 1%. The above test report relates only to the items tested and may not be reproduced in any form without the express written approval of EMSL Analytical, Inc. EMSL's liability is limited to the cost of analysis. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. The test results contained within this report meet the requirements of NELAC unless otherwise noted. Samples received in good condition unless otherwise noted.
Analysis performed by EMSL Ann Arbor (NVLAP #101048-4)



EMSL Analytical, Inc.

212 South Wagner Road, Ann Arbor, MI 48103

Phone: (734) 668-6810 Fax: (734) 668-8532 Email: annarborlab@emsl.com

Attn: **John Rehkopf**
Northern Analytical Services
21391 13 Mile Rd
Leroy, MI 49655

Customer ID: NOAN22
Customer PO:
Received: 08/16/07 10:30 AM
EMSL Order: 080702748

Fax: (866) 214-4739 Phone: (231) 679-0005
Project: **Detroit Light Guard**


EMSL Proj:
Analysis Date: 8/17/2007
Report Date: 8/17/2007

Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Location	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
1101 080702748-0008		Brown Non-Fibrous Heterogeneous	3% Cellulose	97% Non-fibrous (other)	None Detected
1301 080702748-0009	Tile	Brown Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
1301A 080702748-0009A	Mastic	Black Non-Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected
1401 080702748-0010		Black Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
1501 080702748-0011		White Fibrous Heterogeneous	40% Cellulose 40% Glass	20% Non-fibrous (other)	None Detected
1601 080702748-0012		Tan Fibrous Heterogeneous	20% Cellulose	75% Non-fibrous (other)	5% Chrysotile
1602 080702748-0013		Tan Fibrous Heterogeneous	20% Cellulose	75% Non-fibrous (other)	5% Chrysotile
1701 080702748-0014	Tile	Tan Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected

Analyst(s)

Justin Bolton (15)
Todd Miller (15)



or other approved signatory

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Project: **Detroit Light Guard**


EMSL Proj:
Analysis Date: 8/17/2007
Report Date: 8/17/2007

Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Location	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
1701A 080702748-0014A	Mastic	Black Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
1801 080702748-0015	Tile	Brown Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
1801A 080702748-0015A	Mastic	Black Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
1901 080702748-0016	Dry Wall	Gray Fibrous Heterogeneous	30% Cellulose	70% Non-fibrous (other)	None Detected
1901A 080702748-0016A	Mud	White Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
1902 080702748-0017	Dry Wall	Gray Fibrous Heterogeneous	20% Cellulose	80% Non-fibrous (other)	None Detected
1902A 080702748-0017A	Mud	White Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
2001 080702748-0018	Mastic	Gray Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected

Analyst(s)

Justin Bolton (15)
Todd Miller (15)



or other approved signatory

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Analysis Date: 8/17/2007
Report Date: 8/17/2007

Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Location	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
2001A <i>080702748-0018A</i>	Tile	Clear Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
2201 <i>080702748-0019</i>	Tile	White Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
2201A <i>080702748-0019A</i>	Mastic	Yellow Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
2301 <i>080702748-0020</i>	Tile	Green Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
2301A <i>080702748-0020A</i>	Mastic	Yellow Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
2401 <i>080702748-0021</i>		Gray Fibrous Heterogeneous	60% Glass	40% Non-fibrous (other)	None Detected

Analyst(s)

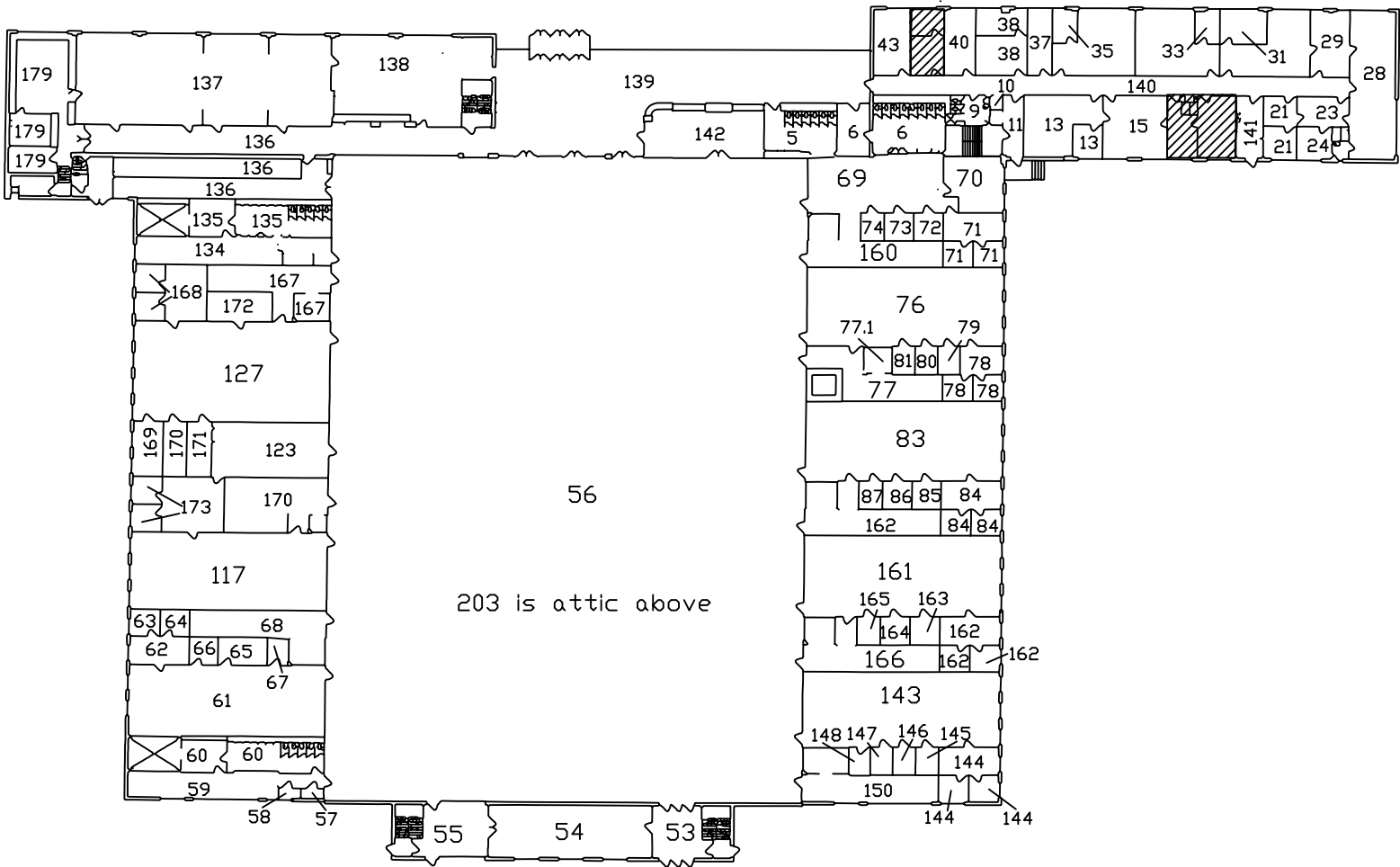
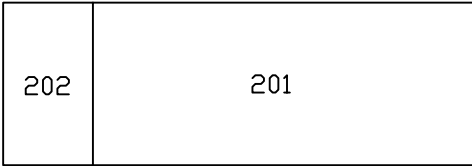
Justin Bolton (15)
Todd Miller (15)



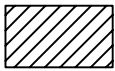
or other approved signatory

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Analysis performed by EMSL Ann Arbor (NVLAP #101048-4)

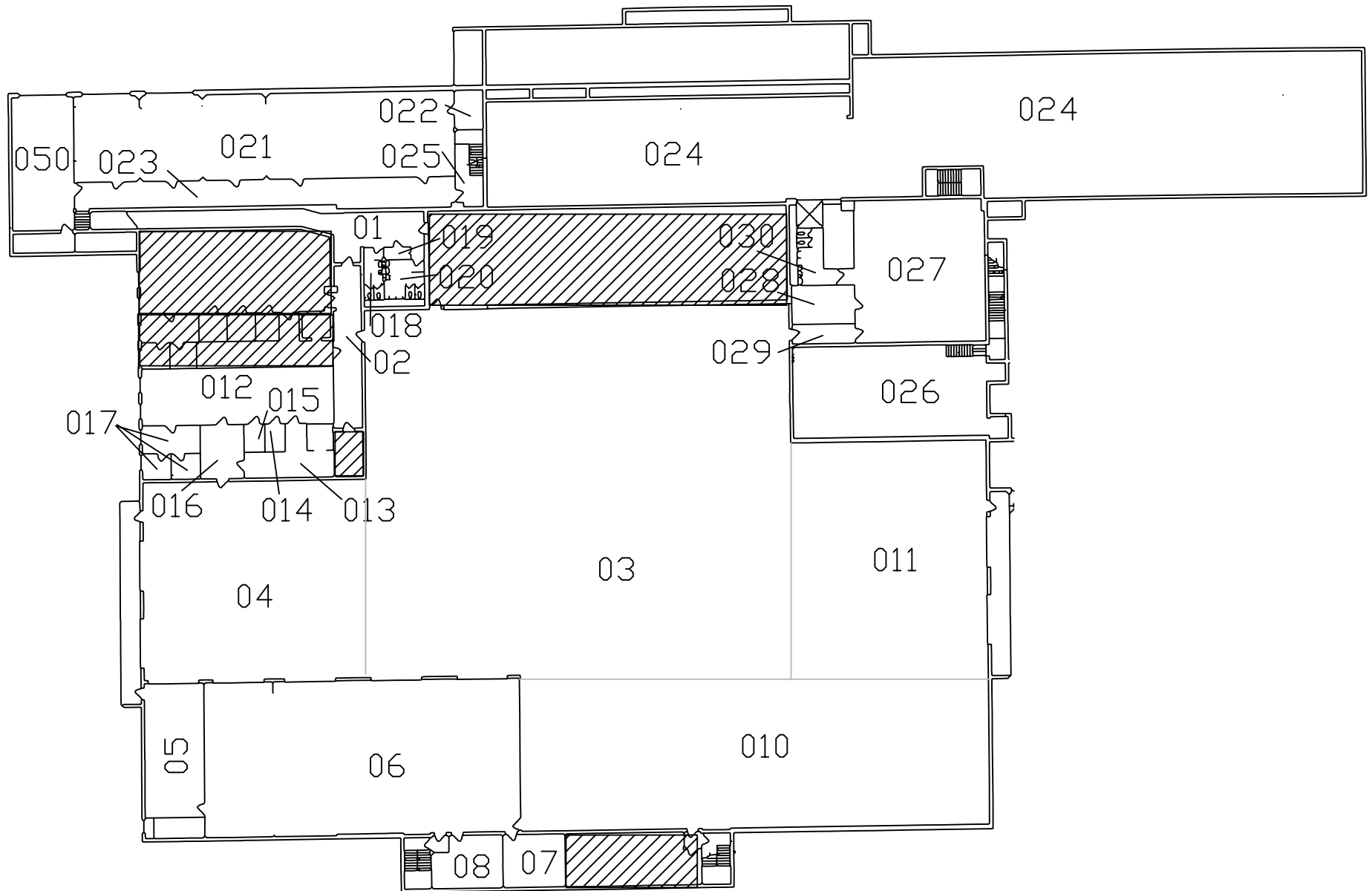
Drawing



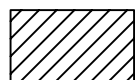
Detroit Light Guard 1st & 2nd Floors



Area Not Included in Survey



Detroit Light Guard Basement



Area Not Included in Survey



Monday, April 10, 2023

Fibertec Project Number: A14375
Project Identification: DLGA-COAL /
Submittal Date: 03/31/2023

Mr. Eric Hein
Michigan Army National Guard, CFMO Env.
Invoice sent to: Lansing Res. Forces Support Center, CFMO Env.
3423 N. Martin Luther King Jr. Blvd.
Lansing, Michigan 48906

Dear Mr. Hein,

Thank you for selecting Fibertec Environmental Services as your analytical laboratory. The samples you submitted have been analyzed in accordance with NELAC standards and the results compiled in the attached report. Any exceptions to NELAC compliance are noted in the report. These results apply only to those samples submitted. Please note TO-15 samples will be disposed of 7 calendar days after the reporting date. All other samples will be disposed of 30 days after the reporting date.

Please note that samples were received at 21.5°C which exceeds the maximum criteria of 6°C.

If you have any questions regarding these results or if we may be of further assistance to you, please contact me at (517) 699-0345.

Sincerely,

A handwritten signature in cursive script that reads "Sue Ricketts".

By Sue Ricketts at 8:20 AM, Apr 10, 2023

For Daryl P. Strandbergh
Laboratory Director

Enclosures

1914 Holloway Drive
11766 E. Grand River
8660 S. Mackinaw Trail

Holt, MI 48842
Brighton, MI 48116
Cadillac, MI 49601

T: (517) 699-0345
T: (810) 220-3300
T: (231) 775-8368

F: (517) 699-0388
F: (810) 220-3311
F: (231) 775-8584



Analytical Laboratory Report
Laboratory Project Number: A14375
Laboratory Sample Number: A14375-001

Order: A14375
Date: 04/10/23

Table with 3 columns: Client Identification, Sample Description, Chain of Custody; Client Project Name, Sample No, Collect Date; Client Project No, Sample Matrix, Collect Time.

Sample Comments:

Definitions: Q: Qualifier (see definitions at end of report) NA: Not Applicable †: Parameter not included in NELAC Scope of Analysis.

Toxicity Characteristic Leaching Procedure (TCLP)
Method: EPA 1311

Aliquot ID: A14375-001 Matrix: Surface Water
Description: 1L Amber

Table with 11 columns: Parameter(s), Result, Q, Units, Reporting Limit, Dilution, Preparation (P. Date, P. Batch), Analysis (A. Date, A. Batch), Init.

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F: (517) 699-0388
F: (810) 220-3311
F: (231) 775-8584



Analytical Laboratory Report
Laboratory Project Number: A14375
Laboratory Sample Number: A14375-001

Order: A14375
 Date: 04/10/23

Client Identification: Michigan Army National Guard, CFMO Env.	Sample Description: 1L Amber	Chain of Custody: 215723
Client Project Name: DLGA-COAL	Sample No: 1	Collect Date: 03/31/23
Client Project No: NA	Sample Matrix: Surface Water	Collect Time: 13:00

Sample Comments:

Definitions: Q: Qualifier (see definitions at end of report) NA: Not Applicable ‡: Parameter not included in NELAC Scope of Analysis.

TCLP RCRA-8 Metals by ICP-MS Aliquot ID: **A14375-001A** Matrix: **TCLP Extract**
 Method: **EPA 3005A (Total Recoverable)/EPA 6020A** Description: **1L Amber**

Parameter(s)	Result	Q	Units	Reporting Limit	Dilution	Preparation		Analysis		
						P. Date	P. Batch	A. Date	A. Batch	Init.
1. Arsenic	U		mg/L	1.0	20	04/07/23	PT23D07E	04/07/23	T423D07A	CJA
2. Barium	U		mg/L	1.0	20	04/07/23	PT23D07E	04/07/23	T423D07A	CJA
3. Cadmium	U		mg/L	0.20	20	04/07/23	PT23D07E	04/07/23	T423D07A	CJA
4. Chromium	U		mg/L	1.0	20	04/07/23	PT23D07E	04/07/23	T423D07A	CJA
5. Lead	U		mg/L	1.0	20	04/07/23	PT23D07E	04/07/23	T423D07A	CJA
6. Selenium	U	V+	mg/L	0.20	20	04/07/23	PT23D07E	04/07/23	T423D07A	CJA
7. Silver	U		mg/L	1.0	20	04/07/23	PT23D07E	04/07/23	T423D07A	CJA

TCLP Mercury Aliquot ID: **A14375-001A** Matrix: **TCLP Extract**
 Method: **EPA 7470A** Description: **1L Amber**

Parameter(s)	Result	Q	Units	Reporting Limit	Dilution	Preparation		Analysis		
						P. Date	P. Batch	A. Date	A. Batch	Init.
1. Mercury	U		mg/L	0.050	1.0	04/07/23	PM23D07A	04/07/23	M723D07A	JLH

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F: (517) 699-0388
 F: (810) 220-3311
 F: (231) 775-8584

Definitions/ Qualifiers:

- A:** Spike recovery or precision unusable due to dilution.
- B:** The analyte was detected in the associated method blank.
- E:** The analyte was detected at a concentration greater than the calibration range, therefore the result is estimated.
- J:** The concentration is an estimated value.
- M:** Modified Method
- U:** The analyte was not detected at or above the reporting limit.
- X:** Matrix Interference has resulted in a raised reporting limit or distorted result.
- W:** Results reported on a wet-weight basis.
- *:** Value reported is outside QC limits

Exception Summary:

- V+** : Recovery in the associated continuing calibration verification sample (CCV) exceeds the upper control limit. Results may be biased high.

Analysis Locations:

All analyses performed in Holt.



Accreditation Number(s):

T104704518-23-15 (TX)

1914 Holloway Drive
11766 E. Grand River
8660 S. Mackinaw Trail

Holt, MI 48842
Brighton, MI 48116
Cadillac, MI 49601

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F: (231) 775-8584



PM23D07A: Method Blank (MB)

EPA 7470A

Run Time: PM23D07A.MB 04/07/2023 11:14 [M723D07A]

Analyte	MB Result	MB Qualifier	MB RDL
Mercury	U		0.050

PM23D07A: Laboratory Control Sample (LCS)

EPA 7470A

Run Time: PM23D07A.LCS: 04/07/2023 11:15 [M723D07A]

Analyte	LCS Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Mercury	0.000250	0.000261	104	85-115	

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F: (231) 775-8584



Quality Control Report

Laboratory Project Number: A14375

PT23D07E: Method Blank (MB)

EPA 6020A

Run Time: PT23D07E.MB 04/07/2023 15:04 [T423D07A]

Analyte	MB Result	MB Qualifier	MB RDL
	mg/L		mg/L
Arsenic	U		1.0
Barium	U		1.0
Cadmium	U		0.20
Chromium	U		1.0
Lead	U		1.0
Selenium	U		0.20
Silver	U		1.0

PT23D07E: Laboratory Control Sample (LCS)

EPA 6020A

Run Time: PT23D07E.LCS: 04/07/2023 15:05 [T423D07A]

Analyte	LCS Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
	mg/L	mg/L	%	%	
Arsenic	2.00	1.91	95	85-115	
Barium	10.0	10.1	101	85-115	
Cadmium	2.00	1.91	96	85-115	
Chromium	4.00	3.72	93	85-115	
Lead	4.00	3.50	88	85-115	
Selenium	2.00	1.94	97	85-115	
Silver	2.00	2.05	102	85-115	

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Cadillac, MI 49601

T: (517) 699-0345
T: (810) 220-3300
T: (231) 775-8368

F: (517) 699-0388
F: (810) 220-3311
F: (231) 775-8584

Definitions/ Qualifiers:

U: The analyte was not detected at or above the Reporting Limit (RL).
***:** Value reported is outside QC limits



Exception Summary:

Exceptions have been properly noted on reported results or affected samples have been scheduled for reanalysis when appropriate.

Report Generated By:



By Sue Ricketts at 8:26 AM, Apr 10, 2023

Client Name: MDMVA (Eric Hein)				MATRIX (SEE RIGHT CORNER FOR CODE)	# OF CONTAINERS	PARAMETERS										Matrix Code			Deliverables		
Contact Person: Eric Hein						HOLD SAMPLE											S Soil	GW	Ground Water		Level 2
Project Name/ Number: DLGA-COAL							A Air	SW	Surface Water		Level 3										
Email distribution list: eric.f.hein, heine@michigan.gov							O Oil	WW	Waste Water		Level 4										
Quote#							P Wipe	X	Other: Specify		EDD										
Purchase Order#				Remarks:																	
Date	Time	Sample #	Client Sample Descriptor																		
3/31	13:00	1	1L Amber	X	2	X															
Comments:				<p>Received by Lab 3/31/23</p> <p>MAR 31 2023</p> <p>Initials: JM</p> <p>Received By Lab</p> <p>MAR 31 2023</p> <p>Initials: JM</p>																	
Sampled/Relinquished By: 				Date/Time	3/31/23 1348	Received By:															
Relinquished By:				Date/Time		Received By:															
Relinquished By:				Date/Time		Received By Laboratory:															
Turnaround Time ALL RESULTS WILL BE SENT BY THE END OF THE BUSINESS DAY												LAB USE ONLY									
<input type="checkbox"/> 1 bus. day <input type="checkbox"/> 2 bus. days <input type="checkbox"/> 3 bus. days <input type="checkbox"/> 4 bus. days <input checked="" type="checkbox"/> 5-7 bus. days (standard) Other (specify time/date requirement): _____												Fibertec project number: A14375 Temperature upon receipt at Lab: 21.5°C									
Please see back for terms and conditions																					

APPENDIX III

SPECIAL PROJECT PROCEDURES

SOIL EROSION AND SEDIMENTATION CONTROL PROJECT PROCEDURES FOR CONTRACTORS ON DTMB OWNED AND MANAGED PROPERTIES

1. Comply with Part 91, Soil Erosion and Sedimentation Control of the Natural Resources and Environmental Protection Act 1994 PA 451, as amended.
2. Contact the DTMB, SFA, Design and Construction Division to discuss the implementation of soil erosion and sedimentation control (SESC) on the Project with DTMB SESC Officer. Phone (517) 388-3045 or Email mcgarryc@michigan.gov.
3. Following the award of a contract, the Contractor will be required to prepare and issue for approval an SESC Implementation Plan, which indicates the Contractor's intended implementation of SESC on the project including a schedule and sequence. The Environmental Health and Safety Section, upon approval of the implementation plan, will issue to the Contractor an "Authorization to Proceed with Earth Change" document, which is to be posted at the job site. This document is issued in lieu of a permit from the county. Earthwork shall not begin prior to the issuance of this Authorization. Upon receipt of the Authorization document, the Contractor may begin earth change activities.
4. See below the "Checklist for Contractor's SESC Implementation Plan" for details of the required information necessary for the Contractor to create the SESC Implementation Plan. The intent of this plan is to ensure that the Contractor has reviewed and understands the SESC provisions within the plans and specifications.
5. CHECKLIST FOR CONTRACTOR'S SOIL EROSION AND SEDIMENTATION CONTROL IMPLEMENTATION PLAN (For projects that include earth changes or disturb existing vegetation):

DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET
STATE FACILITIES ADMINISTRATION, DESIGN AND CONSTRUCTION DIVISION
SOIL EROSION AND SEDIMENTATION CONTROL PROGRAM
P.O. Box 30026, Lansing, Michigan 48909

PROJECT TITLE:
PROJECT LOCATION:
PROJECT FILE NUMBER:
INDEX NUMBER:

Prior to the start of earthwork, the Contractor must submit a Soil Erosion and Sedimentation Control (SESC) Implementation Plan to the Michigan Department of Technology, Management and Budget, Soil Erosion and Sedimentation Control Program. The intent of this plan is to ensure that the Contractor has reviewed and understands the SESC provisions within the plans and specifications. The following checklist will provide Contractors with assistance in creating the SESC Implementation Plan.

The SESC Implementation Plan must include:

1. A written plan or letter demonstrating:
 - The Contractor's means and methods for the implementation of SESC provisions included within the plans and specifications and compliance with the provisions of Part 91 of PA 451 of 1994, as amended.
 - The Contractor's plan for dust control.
 - The Contractor's plan for inspection and maintenance of temporary SESC's.
2. A map, location plan, drawing, or amended copy of the Project SESC or grading plan showing:
 - The locations of any stockpiles of soil associated with the Project
 - The temporary SESC controls associated with stockpiles of soil
 - The Contractor's suggested or proposed additions or relocations of any temporary or permanent SESC's. associated with the Project plans and specifications (subject to approval by Engineer and DTMB)
 - Location of site entrances, exits and vehicle routes
 - Location of site superintendent's/project manager's site trailer or office (for SESC Inspector check-in)
3. A schedule for the installation and removal of temporary controls and the installation of permanent soil erosion and sedimentation controls in relation to the overall construction schedule.

Submit the above items to the above address.

Upon approval of the Contractor's plan, an "Authorization to Proceed with Earth Change" will be issued by DTMB, Design and Construction Division.

DEMOLITION/REMODELING PROJECT PROCEDURES

Furnish all equipment, materials, labor, and services necessary to complete all building demolition required in connection with the existing building, in order to permit the installation of new Work. The goal of the Owner is to generate the least amount of waste or debris possible. However, inevitable waste and debris that are generated shall be reused, salvaged, or recycled, and disposal in landfills shall be minimized to the extent economically feasible. The Contractor will be required to prepare waste management plan for the collection, handling, storage, transportation, and disposal of the waste generated at the construction site for the Owner's review and approval. The Contractor will be required to produce waste management progress reports.

1. Locations: Notations are made in various places on the Drawings to call attention to building demolition which is required; however, these Drawings are not intended to show every item to be removed. The Contractor and the Subcontractors for the various trades must remove the materials related to their respective trades as required to permit the construction of the new Work as shown.
2. Permits: The Contractor must secure from the appropriate agencies all required permits necessary for proper execution of the work before starting work on the project site. All fees for securing the permits must be paid by the Contractor, including all inspection costs which may be legally assessed by the Bureau of Construction Codes in accordance with the authority granted under the Public Act 1980 PA 371, as amended.
3. Enclosures: Where it is necessary to make alterations to walls, floors or roof of the existing building, the Contractor must provide and maintain dustproof partitions to separate the parts where Work is being done from the adjoining parts occupied by the State Agency. Where any parts are opened and exposed to the elements, the Contractor must provide weather tight enclosures to fully protect the structure and its contents.
4. Waste Management Plan: The management plan must address waste source identification and separation, returns, reuse and salvage, recycling, landfill options, alternatives to landfilling, materials handling procedures and transportation.
5. Preparation: Protect all existing Work that is to remain and restore in an approved manner any such Work that becomes damaged.
 - 5.1 Rubbish and debris resulting from the Work must be removed immediately from the site by the Contractor. However, any recyclable materials must be recycled; the Contractor will be required to use alternatives to landfills for waste disposal such as reuse or recycle of asphalt, bricks, concrete, masonry, plastics, paint, glass, carpet, metals, wood, drywall, insulation, and any other waste materials to the extent practical.
 - 5.2 Unless otherwise specified, the Agency will remove existing furniture, drapery tracks, draperies, window blinds, and other equipment items, which might interfere with the new construction.
6. Coordination: Demolition work, in connection with any new unit of Work, must not be commenced until all new materials required for completion of that new item of Work are at hand.
7. Waste Management Plan Progress Reports: Submit an updated report with the payment requests. The progress reports shall include:
 - a. The amount of waste sent to a landfill, tipping fees paid and the total disposal cost. Include supporting documents such as manifests, weight tickets, receipts and/or invoices.
 - b. Records for each material recycled/reused/salvaged from the project including the amount, date removed from the job site, destination, transportation cost, recycled materials, and the net cost/ savings.
 - c. Breakdown of waste by type generated to date.
 - d. Recycling/salvage/landfill rates.
 - e. Percent of waste recycled/salvaged to date.

HAZARDOUS MATERIALS PROJECT PROCEDURES

1. The Contractor must use, handle, store, dispose of, process, transport and transfer any material considered a Hazardous Material in accordance with all federal, state, and local Laws. If the Contractor encounters material reasonably believed to be a Hazardous Material and which may present a substantial danger, the Contractor must immediately stop all affected work, give written notice to the Owner of the conditions encountered, and take appropriate health and safety precautions.
2. This project has been identified by the DTMB-SFA as having a possibility of containing Hazardous Waste materials to be legally removed from the Project job site to complete the Work as described in the Proposal and Contract. If removal of friable asbestos material is required, the Contractor must contact the Air Quality Division, Department of Environment, Great Lakes, and Energy, at **(517) 284-6773**, for a permit and furnish all training, labor, materials, services, insurance, and equipment necessary to carry out the removal operations of all Hazardous Materials from the Project job site, as identified by the Scope of Work, or encountered on the Project job site, in accordance with State and Federal Hazardous Waste Codes. A Contract Change Order will be written to modify the existing Contract to pay for the additional cost.
3. Environmental Hazards (air, water, land and liquid industrial) are handled by the Waste and Hazardous Materials Division, Michigan Department of Environment, Great Lakes, and Energy (EGLE) in carrying out the requirements of the Federal Environmental Protection Agency (EPA). For general information and/or a copy of the latest regulations and publications call (517) 335-2690.
4. The Michigan Occupational Safety and Health Administration (MIOSHA) provides protection and regulations for the safety and health of workers. The Department of Licensing and Regulatory Affairs provides for the safety of workers. The Department of Community Health provides for the health of workers (517/373-3740) (TDD 517/373-3573).
 - 4.1 Contractor must post any applicable State and/or Federal government regulations at the job site in a prominent location.
 - 4.2 Contractor must be responsible for training their workers in safe work practices and in proper removal methods when encountering hazardous chemicals.
5. Applicable Regulations:
 - 5.1 Natural Resources and Environmental Protection Act – PA 451 of 1994, as amended, including Part 111 – Hazardous Waste Management, Part 121 – Liquid Industrial Waste and Part 147 – PCB compounds.
 - 5.2 RCRA, 1976 - Resource Conservation and Recovery Act: This federal statute regulates generation, transportation, treatment, storage, or disposal of hazardous wastes nationally.
 - 5.3 TSCA, 1979 – Toxic Substances Control Act: This statute regulates the generation, transportation, storage, and disposal of industrial chemicals such as PCBs.
6. Definitions: Hazardous substances are ignitable, corrosive, reactive, and/or toxic, based on their chemical characteristics.
 - 6.1 Under Federal and Michigan Law, a Small Quantity Generator of hazardous waste provides from 220 to less than 2,000 lbs./month or never accumulates 2,200 lbs. or more.
 - 6.2 A Generator size provider of hazardous waste provides 2,200 lbs. or more/month or accumulates above 2,200 lbs.
7. Disposals: To use an off-site hazardous waste disposal facility, the Contractor must use the Uniform Hazardous Waste Manifest (shipping paper). Small quantities of hazardous waste may not be disposed of in sanitary landfills used for solid waste.
8. Federal, state, and local Laws and regulations may apply to the storage, handling and disposal of Hazardous Materials and wastes at each State Agency. Contact the **Environmental Assistance Center** of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) at **1-800-662-9278**, Fax to: 517-241-0673 or e-mail to: DEQ-EAD-env-assist@michigan.gov for general EGLE information including direct and referral assistance on air, water and wetlands permits; contaminated site clean-ups; underground storage tank removals and remediation; hazardous and solid waste disposal; pollution prevention and recycling; and compliance-related assistance. The Center provides businesses, municipalities, and the public with a single point of access to EGLE's environmental programs.

ASBESTOS ABATEMENT PROJECT PROCEDURES

Should this Work require the renovation or demolition of a building or structure initially constructed on or prior to 1980, the Contractor will use the attached copy of a Comprehensive Asbestos Building Survey for those portions of the building or structure being impacted and must plan his or her work to minimize disturbance of any known or assumed asbestos containing materials (ACM). In addition, if this building or structure was constructed on or prior to 1980, the Contractor's On-Site Superintendent and all Subcontractor On-Site Superintendents for trades that could potentially disturb known or assumed ACM, must, as a minimum, have and provide documentation of current Asbestos Awareness Training.

If the Comprehensive Asbestos Building Survey identifies known or assumed ACM that will potentially be disturbed as a part of the Contractor's renovation or demolition activities, the Contractor must remove, transport, and dispose of these materials at no additional cost to the Owner and prior to any other work taking place within the immediate vicinity of said material. If required, the Contractor must provide the Owner a minimum of 10 working day notification prior to the start of any asbestos abatement activities with abatement in occupied buildings being completed even if they will be conducted during off hours (nights, weekends, and state holidays).

If the Contractor encounters a suspected ACM that was not previously identified within the Comprehensive Asbestos Building Survey, the Contractor must immediately stop all affected work, give written notice to the Owner of the conditions encountered, and take appropriate health and safety precautions. If, after providing Owner notification, the Contractor is directed to sample and/or remove the suspected ACM in question, a Contract Change Order will be written to modify the existing Contract to pay for the additional cost. Any abatement shall be completed in accordance with the requirements of this Section.

If removal of ACM is required, removal must be completed by a contractor currently licensed to remove asbestos by the State of Michigan, Department of Licensing and Regulatory Affairs (DLARA) Asbestos Program and abatement must be performed in accordance with all federal, state, and local Laws and Regulations. Prior to commencing any asbestos abatement activities, the licensed abatement contractor must submit, as required by Federal, State and Local Laws and Regulations, a "Notification of Intent to Renovate/Demolish" to both the State of Michigan, Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division and to the DLARA, Asbestos Program, to comply with National Emission Standards for Hazardous Air Pollutants (NESHAP), and the Clean Air Act (CAA). All regulated ACM must be disposed of at an approved Type II (general refuse) landfill and must be in leak-tight wrapping or containers. ACM that is non friable and is not in poor condition or will not become regulated ACM at any time can be disposed of in a Type III (construction debris) landfill.

At the completion of each abatement activity, the Contractor must perform clearance testing in accordance with National Institute for Occupational Safety and Health (NIOSH) 582 "Sampling and Evaluating Airborne Asbestos Dust". All air samples shall indicate concentrations of less than 0.01 fibers/cc for clearance to be met. Clearance testing shall be performed by a third-party Asbestos Consultant. The Asbestos Consultant selected by the Contractor shall be experienced and knowledgeable about the methods for asbestos air sampling and be able to select representative numbers and locations of samples. It is mandatory that the Asbestos Consultant's on-site hygienist performing sampling and analysis have certification that he/she has passed a NIOSH 582 or equivalent course.

The NESHAP asbestos regulations, notification form, guidelines and fact sheets are available on EGLE's web site www.michigan.gov/egle under heading Air; then click on Compliance; then click on Asbestos NESHAP Program. For guidelines on submitting notifications pursuant to the Asbestos Contractors Licensing Act, contact the DLARA, Occupational Health Division, Asbestos Program at (517) 322-1320 or visit DLARA's web site www.michigan.gov/asbestos.

LEAD ABATEMENT PROJECT PROCEDURES

Should this Work require the renovation or demolition of a building or structure, the workers are assumed to be exposed to lead or materials containing lead above acceptable levels until proven otherwise through personal air sampling and analysis. The Contractor shall take all steps necessary to assure that his/her employees, are not exposed to lead at concentrations greater than the Permissible Exposure Limit as per the State of Michigan Department of Licensing and Regulatory Affairs Occupational Health Standards Part 603 "Lead Exposure in Construction". In addition, the Contractor shall convey this same requirement to all subcontractors that may be under his/her control.

The employer shall comply with the Michigan Lead Abatement Act, as amended, and the Lead Hazard Control rules and must communicate information concerning lead hazards according to the requirements of Michigan Occupational Safety and Health Administration (MIOSHA) Part 603 and the Occupational Safety and Health Administration's (OSHA's) Hazard Communication Standard for the construction industry, 29 CFR 1926.59, including but not limited to safety equipment (e.g. personal fit-tested and approved respirators and protective clothing), worker rotation (on a short-cycle and regular basis), working practices (e.g. sanding, cutting, grinding, abraded, burning and heat-gun stripping of lead based paint are not allowed), the requirements concerning warning signs and labels, Safety Data Sheets (SDS), and employee information and training. Employers shall comply with the requirements of 29 CFR 1926.62(l) - Employee Information and Training.

If lead or materials containing lead will be disturbed as a part of the work to be performed, the Contractor must remove, transport, and dispose of these materials at no additional cost to the Owner and prior to any other work taking place within the immediate vicinity of said material. The Contractor must provide the Owner a minimum 10 working day notification prior to the start of any lead abatement activities with abatement in occupied buildings being completed even if they will be conducted during off hours (nights, weekends, and state holidays). Abatement is defined as an activity specifically designed to permanently remove lead paint, lead-contaminated dust or other lead containing materials, the installation of a permanent enclosure or encapsulation of lead paint or other lead containing materials, the replacement of lead-painted surfaces or fixtures, the removal or covering of lead-contaminated soil, and any preparation, cleanup, disposal, and post-abatement clearance testing associated with these activities. Renovation, remodeling, landscaping, or other activity, that is not designed to permanently eliminate lead paint hazards, but is instead designed to repair, restore, or remodel a structure, or housing unit even though the activity may incidentally result in a reduction or elimination of a lead paint hazard is not considered abatement.

If abatement of lead or materials containing lead is required, abatement must be completed by a qualified Lead Abatement Contractor. In addition, Specifications for the Lead Abatement should be based upon a Lead Inspection/Risk Assessment report. The Lead Inspection/Risk Assessment report and clearance testing upon completion should be performed by a Certified Inspector or Risk Assessor. Lead abatement including clearance testing shall be performed in accordance with the State of Michigan, Lead Abatement Act, Part 54A Lead Abatement and with all other federal, state, and local Laws and Regulations that may apply.

For additional information about certifications, guidance, and regulations for lead hazard control activities, visit www.michigan.gov/lead.

APPENDIX IV
WAGE RATES

"General Decision Number: MI20230101 02/24/2023

Superseded General Decision Number: MI20220101

State: Michigan

Construction Type: Building

County: Wayne County in Michigan.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	<ul style="list-style-type: none">. Executive Order 14026 generally applies to the contract.. The contractor must pay all covered workers at least \$16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	<ul style="list-style-type: none">. Executive Order 13658 generally applies to the contract.. The contractor must pay all covered workers at least \$12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/06/2023
1	02/03/2023

ASBE0025-002 06/01/2022

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 36.63	32.91

BOIL0169-001 01/01/2021

	Rates	Fringes
BOILERMAKER.....	\$ 35.95	34.52

* BRMI0001-001 06/01/2022

	Rates	Fringes
BRICKLAYER.....	\$ 38.87	25.18
TILE FINISHER.....	\$ 30.75	22.67
TILE SETTER.....	\$ 37.88	22.67

CARP0687-003 06/01/2021

	Rates	Fringes
CARPENTER (Including Acoustical Ceiling Installation, Drywall Hanging, Form Work, Metal Stud Installation & Scaffold Building).....	\$ 35.16	29.22

CARP1045-001 06/01/2020

	Rates	Fringes
CARPENTER (Floor Layer - Carpet, Resilient, & Vinyl Flooring).....	\$ 30.60	24.58

CARP1102-002 06/01/2020

	Rates	Fringes
MILLWRIGHT.....	\$ 35.30	34.10

ELEC0058-001 07/21/2022

	Rates	Fringes
ELECTRICIAN (Low Voltage Wiring and Installation of Alarms) Installer.....	\$ 30.12	14.57
Technician.....	\$ 39.33	14.95
ELECTRICIAN.....	\$ 48.52	26.11

ELEV0036-002 01/01/2023

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 59.82	37.335+a+b

FOOTNOTES:

A. PAID HOLIDAYS: New Years Day; Memorial Day; Independence Day; Labor Day; Veterans' Day; Thanksgiving Day; the Friday after Thanksgiving Day; and Christmas Day.

B. Employer contributes 8% basic hourly rate for 5 years or more of service of 6% basic hourly rate for 6 months to 5 years of service as vacation pay credit.

ENGI0324-017 06/01/2022

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 46.44	24.95
GROUP 2.....	\$ 44.94	24.95
GROUP 3.....	\$ 43.44	24.95
GROUP 4.....	\$ 43.14	24.95
GROUP 5.....	\$ 42.32	24.95
GROUP 6.....	\$ 41.46	24.95
GROUP 7.....	\$ 40.49	24.95
GROUP 8.....	\$ 38.78	24.95
GROUP 9.....	\$ 30.44	24.95

FOOTNOTES:

Tower cranes: to be paid the crane operator rate determined by the combined length of the mast and the boom. If the worker must climb 50 ft. or more to the work station, \$.25 per hour additional.

Derrick and cranes where the operator must climb 50 ft. or more to the work station, \$.25 per hour additional to the applicable crane operator rate.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane with boom and jib or leads 400' or longer

GROUP 2: Crane with boom and jib or leads 300' or longer

GROUP 3: Crane with boom and jib or leads 220' or longer

GROUP 4: Crane with boom and jib or leads 140' or longer

GROUP 5: Crane with boom and jib or leads 120' or longer

GROUP 6: Regular crane operator, and concrete pump with boom operator

GROUP 7: Backhoe/Excavator/Trackhoe, bobcat/skid Loader, broom/sweeper, bulldozer, grader/blade, highlift, hoist, loader, roller, scraper, tractor & trencher

GROUP 8: Forklift & extend-a-boom forklift

GROUP 9: Oiler

IRON0025-019 06/01/2022

	Rates	Fringes
IRONWORKER		

REINFORCING.....	\$ 31.43	34.77
STRUCTURAL.....	\$ 34.50	38.44

IRON0025-022 06/01/2022

	Rates	Fringes
IRONWORKER STRUCTURAL (Metal Building Erection Only).....	\$ 25.81	26.43

LAB00259-002 08/01/2022

	Rates	Fringes
LABORER: Asbestos Abatement (Removal from Floors, Walls & Ceilings).....	\$ 32.78	14.97

LAB00334-005 06/01/2022

	Rates	Fringes
LABORER: Landscape & Irrigation		
GROUP 1.....	\$ 23.82	7.60
GROUP 2.....	\$ 21.60	7.60

CLASSIFICATIONS

GROUP 1: Landscape specialist, including air, gas and diesel equipment operator, lawn sprinkler installer, skidsteer (or equivalent)

GROUP 2: Landscape laborer: small power tool operator, material mover, truck driver and lawn sprinkler installer tender

LAB01191-002 06/01/2022

	Rates	Fringes
LABORER Common or General; Grade Checker; Mason Tender - Brick/Cement/Concrete; Pipelayer; Sandblaster.....	\$ 29.95	16.95

PAIN0022-003 06/01/2022

	Rates	Fringes
PAINTER: Brush and Roller.....	\$ 32.85	20.41
PAINTER: Drywall Finishing/Taping.....	\$ 32.85	20.41
PAINTER: Spray.....	\$ 26.86	17.66

PAIN0357-002 06/01/2022

	Rates	Fringes
GLAZIER.....	\$ 37.15	20.98

PAID HOLIDAYS: New Year's Day, Decoration Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day;

provided that the employee has worked the last full regular scheduled work day prior to the holiday, and the first full regular scheduled work day following the holiday, provided the employee is physically able to work.

 PLAS0067-001 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 30.63	14.07

 PLAS0067-004 04/01/2014

	Rates	Fringes
PLASTERER.....	\$ 30.63	14.07

 * PLUM0098-001 06/01/2022

	Rates	Fringes
PLUMBER, Excludes HVAC Pipe and Unit Installation.....	\$ 35.24	30.54

 PLUM0636-003 06/05/2022

	Rates	Fringes
PIPEFITTER, Includes HVAC Pipe and Unit Installation.....	\$ 41.60	29.35

 ROOF0149-001 07/01/2021

	Rates	Fringes
ROOFER.....	\$ 38.16	25.91

 SFMI0704-001 08/01/2022

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers).....	\$ 48.17	30.99

 SHEE0080-004 06/01/2022

	Rates	Fringes
SHEET METAL WORKER (Including HVAC Duct Installation; Excluding HVAC System Installation).....	\$ 47.64	26.15

 TEAM0247-001 06/01/2018

	Rates	Fringes
TRUCK DRIVER GROUP 1 Flatbed; Pickup; Dump & Tandem.....	\$ 26.71	0.70+a
GROUP 2 Semi.....	\$ 26.86	0.70+a
GROUP 3		

Lowboy.....\$ 26.96 0.70+a

PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. If any of the above holidays fall on a Sunday, the following Monday shall be considered the holiday and, if work is performed, the rate shall be double time.

FOOTNOTE:

a. \$456.70 per week, plus \$67.10 per day.

* SUMI2011-026 02/01/2011

	Rates	Fringes
INSTALLER - OVERHEAD DOOR.....	\$ 27.98	0.00
IRONWORKER, ORNAMENTAL.....	\$ 18.48	7.93
TRUCK DRIVER: Tractor Haul Truck.....	\$ 13.57 **	1.18

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$16.20) or 13658 (\$12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage

determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"