

SET #

PROJECT MANUAL

Project:

HVAC Upgrades

**Lauderdale County Animal Shelter
Meridian, Mississippi**

Owner:

**Lauderdale County
Meridian, Mississippi**

CONTRACT DOCUMENTS

September 17, 2024



ERG PN: 22.006



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DIVISION 00

**PROCUREMENT AND CONTRACTING
REQUIREMENTS**

SECTION 001113 – ADVERTISEMENT FOR BIDS

Notice is hereby given that the Board of Supervisors of Lauderdale County, Mississippi, will receive sealed bids until 2:00 PM on Wednesday, October 23, 2024, for the following:

LDC Bid No. #3993 - ERG P.N.: 22.006

HVAC Replacement
Lauderdale County Animal Shelter
Marion, MS

Detailed specifications and contract documents can be obtained upon request from:

Professional: Engineering Resource Group, Inc.
Address: 350 Edgewood Terrace Drive
Jackson, MS 39206
Phone: (601)362-3552
Email: hlemmon@ergms.com

A non-refundable deposit of (\$100.00) One Hundred Dollars is required for printed sets. There is no deposit for electronic (PDF) documents.

Documents can also be downloaded from the Lauderdale County Board of Supervisors website at, <https://lauderdalecounty.org/bids> or Central Bidding at www.centralbidding.com. To be a valid delivery, sealed bids must be delivered in one of the following methods.

Electronic Bids can be submitted via Central Bidding at www.centralbidding.com.

For any questions relating to the electronic bidding process, please call Central Bidding at 225-810-4814.

Sealed Bids can be submitted by mail via USPS, by courier service i.e., FedEx or by hand to the Lauderdale County Board of Supervisors Purchasing Agent, 612 22nd Avenue S, 2nd Floor Government Complex, Meridian, MS., during the hours of 8:00 a.m. to 5:00 p.m., Monday through Friday up until 2:00 P.M. on October 23rd.

A pre-bid meeting will be held at 10:00 A.M. on Friday, October 04, 2024, in the Lauderdale County Board Room located on the 1st Floor of 612 22nd Avenue S, Meridian, MS 39301.

Bid preparation will be in accordance with Section 002113 – Instructions to Bidders bound in the Project Manual. The Owner reserves the right to waive irregularities and to reject any or all bids.

NOTE: Telephones and desks will not be available for bidders use at the bid site.

Dates of Publication:

September 19, 2024

September 26, 2024

END OF SECTION 001113

FURNISH US PROOF OF PUBLICATION....

Stephanie Jackson
Lauderdale County Board of Supervisors
612 22nd Avenue S, 2nd Floor
Meridian, MS 39301

SECTION 002113 – INSTRUCTIONS TO BIDDERS

PART 1 - GENERAL

1.1 OWNER

- A. Lauderdale County, Mississippi

1.2 PROJECT

- A. HVAC Upgrades
Lauderdale County Animal Shelter
Marion, MS

1.3 QUESTIONS

- A. Questions should be directed to Engineering Resource Group (ERG). Should a Bidder find discrepancies in, or omissions from the plans and specifications, or be in doubt as to their meaning, the Bidder should immediately notify ERG in writing. Engineering Resource Group (ERG) will send written instruction(s) or interpretation(s) to all known holders of the documents. Neither the Owner nor the Design Professional will be responsible for nor bound by any oral instruction or interpretation. Contact Engineering Resource Group, Inc., (hlemon@ergms.com), Phone- (601)362-3552; Facsimile – (601)366-6418.

1.4 BIDDERS QUALIFICATIONS

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

1.5 PERFORMANCE BOND

- A. On construction projects that exceed twenty-five thousand dollars (\$25,000.00), a Performance Bond is required. The performance bond must be issued through a licensed MS agent and will be made a part of the construction contract agreement. See Section 006000 – Contract Bonds.

1.6 TAX ON CONSTRUCTION

- A. It is incumbent upon the bidder to be familiar with the laws of the state concerning tax on construction.

1.7 DISQUALIFICATION OF BIDDER

- A. The Owner reserves the right to award to other than the low Bidder when, in the Owner's judgment, it is in his best interest to do so. A Bidder may be disqualified for such reasons as:
1. Bidder's failure to sign Bidder's Proposal Form, Section 004113 – Bid Proposal Form, or to otherwise properly complete the Proposal Form.
 2. Bidder being in arrears on existing contracts.
 3. Bidder being in litigation with the Owner.
 4. Bidder having defaulted on a previous contract.
 5. Bidder having performed unsatisfactorily on a previous contract, including but not limited to the Bidder's failure to fulfill the warranty obligations of a previous contract with the Owner.
 6. Firms that have worked for the Owner in the previous twelve months prior to the bid date of the project whose work has been considered by the Owner to be below the quality generally accepted in the industry; or firms who, in the same period, have failed to deliver work in a timely manner on prior Owner's construction projects will not be permitted to bid on this project.
 7. The above is not an inclusive list.

1.8 CONDITIONS OF WORK

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

1.9 EXAMINATION OF SITE

- A. All Bidders, including subcontractors, shall visit the Project site, compare the plans and specifications with any work in place and be informed of all conditions. Failure to visit the site will in no way relieve the successful Bidder from furnishing any materials or performing any work required to complete work in accordance with the plans and specifications without additional cost to the Owner.

1.10 LAWS AND REGULATIONS

- A. The Bidder must comply with applicable laws, rules and regulations of all authorities having jurisdiction over the Project at no additional costs to the Owner whether such laws, ordinances, rules and regulations are adopted or enacted before or after bid opening.

1.11 OBLIGATION OF BIDDER

- A. At the bid opening, each Bidder will be presumed to have inspected the site, read and become thoroughly familiar with the plans and specifications, including all addenda.

1.12 PRE-BID CONFERENCE

- A. A pre-bid conference will be scheduled, and notification sent out via memorandum or addendum. The pre-bid conference will be held at the project site.

PART 2 - PROPOSAL FORM

2.1 METHOD OF BIDDING

- A. Lump sum bids received from General Contractors which shall include general, mechanical, electrical and demolition work as well as other work shown on and reasonably inferable from the plans and specifications.

2.2 PROPOSAL FORMS

- A. The Bidder shall submit its proposal in duplicate on forms provided and shall fill all applicable blank spaces without interlineation or alteration and must not restate the work to be done. Forms must be typed or written in ink and any alterations to bid prices must be initialed. No oral proposals will be considered.
- B. All received bid proposals shall be binding for a minimum of sixty (60) days from bid date.
- C. By submission of its bid, Bidder agrees to commence work on or before the date specified in a written notice to proceed and to fully complete the work within the time stated in the bid proposal form.

2.3 ALTERNATES

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

2.4 SUBSTITUTIONS

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

2.5 BIDDER IDENTIFICATION

- A. Signature: The Proposal Form shall be signed in ink by any individual authorized to bind the Bidder.
- B. Name of Bidder: The name appearing on the Proposal Form should be the same as the name appearing in the current Mississippi State Board of Contractors Roster.
- C. Legal Address: The address appearing on the Proposal Form should be the same address appearing in the current Mississippi State Board of Contractors Roster.

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

2.6 BID SECURITY

- A. The Bid Security, which must accompany each Bid, shall be in the form of a Bid Bond, or a Certified Check:
 - 1. Bid Bond: The Bidder may submit a Bid Bond by a Surety licensed in Mississippi in the amount of five percent (5%) of the base Bid. The Bid Bond shall be duly executed by the Bidder, the Surety and a Mississippi resident agent. (No standard form is required for the Bid Bond.)
 - 2. Certified Check: The Bidder may submit a certified check payable to Owner in the amount of five percent (5%) of the base Bid. All checks received from Bidders will be returned upon request, unless a Bidder is one (1) of the three (3) apparent low Bidders. The three (3) apparent low Bidder's' checks will be held for forty-five (45) days, unless a Contract is awarded and executed in less time. Personal and company checks that are not bank encumbered are not acceptable bid securities.
 - 3. Bids received that do not accompany the Bid Security will not be considered.

2.7 POWER OF ATTORNEY

- A. Each bid bond must be accompanied by an appropriate Power of Attorney.

PART 3 - SUBMITTING THE PROPOSAL FORM

3.1 SUBMITTAL

- A. A bid must be delivered to the address indicated on the Advertisement for Bids prior to the time and date stated for opening of Bids. Bids shall be submitted in sealed opaque envelope marked, mailed or hand-delivered as follows:

Name of Bidder

(As it appears in the current Mississippi State Board of Contractors Roster)

Lauderdale County Administrator, Chris Lafferty
410 Constitution Avenue, 11th Floor
Meridian, MS 39301

Bid for: HVAC Upgrades Lauderdale County Animal Shelter

Date:

- B. If the Bid is mailed, the bid envelope shall be placed inside a second envelope to prevent inadvertent premature opening of the Proposal.

3.2 MODIFICATION TO BID

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

3.3 WITHDRAWAL OF BID

- A. Any bid may be withdrawn prior to the scheduled time for opening of bids or authorized postponement of same. Any bid received after the date and time specified will not be considered. However, bids received at the scheduled time constitute irrevocable offers to contract at the price in the bid and may not be withdrawn until sixty (60) days after opening of bids. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

PART 4 - BID OPENING AND AWARD OF CONTRACT

4.1 OPENING OF BIDS

- A. Bids will be opened privately by the Owner.

4.2 IRREGULARITIES

- A. The omission of any information requested on the Proposal Form may be considered as an informality, or irregularity, by the Owner when in his opinion the omitted information does not alter the amount contained in the submitted bid proposal, or place other Bidders at a disadvantage.

4.3 ERRORS

- A. Any claim of error and request for release from bid must be delivered in writing to the Owner within twenty-four (24) hours after the bid opening. The Bidder shall provide sufficient documentation with the written request clearly proving an error was made and the Bidder's intended bid.

4.4 AWARD OF CONTRACT

- A. The Owner reserves the right to reject any or all bids and to waive any and all irregularities. If awarded, a contract will be awarded, as soon as possible, to a responsible Bidder whose responsive bid proposal is the lowest and best bid, provided the bid is reasonable and it is to the best interest of the Owner to accept it.

4.5 FAILURE TO ENTER INTO A CONTRACT

- A. The Bidder shall forfeit the Bid Security to the Owner as liquidated damages for failure, or refusal, to execute and deliver the Contract, Bond and Certificate of Insurance within the required ten (10) days after notice of the acceptance of the bid.

4.6 SECURITY FOR FAITHFUL PERFORMANCE

- A. Simultaneously, with delivery of the executed Contract, the Contractor will furnish Performance and Payment Bonds, as security for faithful performance, the payment of all persons performing labor on the project, and furnishing materials in connection with this Contract. The Surety on such Bonds will be a duly authorized surety company licensed to do business in Mississippi and satisfactory to the Owner and meeting all of the following requirements:
1. Licensed at the time of award by the State of Mississippi's Commissioner of Insurance for the purpose of providing surety.
 2. Listed at the time of award in the Department of the Treasury's Federal Register as a company holding certificates of authority as acceptable sureties on Federal Bonds, commonly referred to as the Treasury List.
 3. All Bonds shall be executed on the form acceptable to Owner.
 4. All Bonds shall be countersigned by a Mississippi resident agent with the name and address typed, or lettered legibly.
 5. All Bonds must be accompanied by an appropriate Power of Attorney.

4.7 INSURANCE

- A. Prior to beginning work on the site, a Certificate of Insurance must be delivered to the Owner. See Project Specifications for requirements.

PART 5 - BIDDER'S CHECKLIST

5.1 PROPOSAL FORM

- A. Base Bid.
- () Write in the amount of the base bid in words and numbers.
- B. Alternates.
- () Write in each alternates amount in words and numbers.
- C. Addenda.
- () Acknowledge the receipt of each addendum by writing in the number of the addendum and the date received.
- D. Acceptance.
- () Proposal is signed by authorized person.
- () Name of Business as it appears in the current Mississippi State Board of Contractors Roster.
- () Legal address of the business listed above.
- () Correct Certificate of Responsibility Number(s) as it appears in the current Mississippi State Board of Contractors Roster.

5.2 BID SECURITY

A. Bid security.

Included Bid Bond

or

Included Certified Check

5.3 POWER OF ATTORNEY

A. Power of attorney.

Included Power of Attorney for Bid Bond

END OF SECTION 002113

SECTION 004113 – BID PROPOSAL FORM

To: Lauderdale County Administrator
Chris Lafferty
612 22ND Avenue S. 2nd Floor Government Complex
Meridian, MS 39301

Project: HVAC Upgrades
Lauderdale County Animal Shelter
Marion, MS

Having carefully examined all conditions of the Contract and all Amendments, Supplements and Addenda thereto, having visited the site and being familiar with the conditions thereof, I or We propose to furnish all labor, materials and equipment to complete all work required by the Contract Documents entitled HVAC UPGRADES, LAUDERDALE COUNTY ANIMAL SHELTER for the amount set forth below:

BASE BID (Write in the amount of the base bid in words and numbers. The written word shall govern.)

Words _____ Dollars (\$ _____)

TIME OF COMPLETION

I propose to complete all work in accordance with the Project Manual and Drawings within 365 consecutive calendar days from written Notice to Proceed.

LIQUIDATED DAMAGES

The stipulated liquidated damages described in Paragraph 9.11 of the Supplementary Conditions are in the amount of Two Hundred Fifty Dollars and No/100----- Dollars (\$250.00) for each calendar day.

ALLOWANCES

None

ADDENDA ACKNOWLEDGEMENT

Bidder acknowledges receipt of the following Addenda:

Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____

ACCEPTANCE

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

Signature _____ Date _____

Name & Title _____

Business Name _____

Complete spelling of bidder's name and address – exact as recorded at the Secretary of State

Address (mailing) _____

Address (physical) _____

City/State/Zip Code _____

Phone _____ Fax _____ email _____

I, or We, agree to hold our bid open for acceptance for sixty (60) calendar days from the date of opening of bids.

Enclosed herewith is Bid Bond or Certified Check in an amount equal to five percent (5%) of the Base Bid, guaranteeing the Owner the execution of the Performance and Payment Bonds and the Contract.

BIDDER'S CERTIFICATE OF RESPONSIBILITY NUMBER(S) _____

GUARANTEE OF WORK

Upon completion of work and prior to final payment, the Contractor shall provide the Owner with a written guarantee warranting that all workmanship and materials are free from defects and that he shall promptly repair or replace without additional cost to the Owner any defects which evidence themselves within one (1) year after date of completion and acceptance of work.

MECHANICAL / PLUMBING / ELECTRICAL CONTRACTORS

Regarding said Divisions of the Specifications of the Standard Form of Agreement Between The Owner and The Contractor: List any Mechanical, Plumbing and/or Electrical Sub-Contractors that will perform work of this contract. COR must be included where sub-contract exceeds \$50,000.00. If no sub-contractor is listed, and such work is within scope of contract and over \$50,000.00, bidder's own COR classification(s) must be sufficient to self-perform any such work. If no sub-contractor is listed, then use of sub-contractor to perform such scope will not be permitted.

Mechanical Contractor _____ Certificate of Responsibility No. _____

Plumbing Contractor _____ Certificate of Responsibility No. _____

Electrical Contractor _____ Certificate of Responsibility No. _____

END OF SECTION 004113

SECTION 005214 – STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Owner will use the Standard Form of Agreement between Owner and Contractor where the basis of payment is a Stipulated Sum, AIA Document A101, 2007 as a part of the Contract Documents.

END OF SECTION 005214

SECTION 006000 – CONTACT BONDS

PART 1 - GENERAL

1.1 PERFORMANCE BOND

- A. The Contractor shall provide an executed AIA Document A312, 2010 Performance Bond as part of the contract Documents.
- B. Performance bond shall be issued by a company on the Department of the Treasury's List of Approved Sureties, as per Circular 570.

1.2 PERFORMANCE BOND SUPPLEMENTS

- A. The following supplements modify, change, delete from or add to the Performance Bond AIA Document A312, 2010 and must be included in the executed document.
 - 1. Add the phrases "all of its obligations of" after the word "performs" and "in accordance with the terms thereof" after the words "the Construction Contract".

1.3 PAYMENT BOND

- A. The Contractor shall provide an executed AIA Document A312, 2010 Payment Bond as part of the Contract Document. No modifications, changes or deletions are required for the Payment Bond.

1.4 STATE LAW

- A. The above mentioned documents are construction industry standards but whenever a conflict arises between the documents and State of Mississippi Law, the State law governs.

1.5 POWER OF ATTORNEY

- A. Each Bond must be accompanied by an appropriate Power of Attorney.

END OF SECTION 006000

SECTION 006500 – CERTIFICATE OF INSURANCE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The *Certificate of Insurance* is a tabulation of insurance required for this Project as specified in Article 11 entitled *Insurance and Bonds* in the General Conditions (AIA Document A201, 2007 edition).
- B. The *Certificate of Insurance* must be completed, certified by the original signature of a Mississippi Resident Insurance Agency and bound in each set of the Contract Documents.
- C. Indicate Insured, Project, Companies providing coverage, policy numbers and policy periods in the blanks as applicable.
- D. If the “OWNERS / CONTRACTORS PROTECTIVE LIABILITY” insurance is part of the Commercial General Liability Insurance Policy, or included by endorsement, indicate the policy number and period of the CGL policy in the “OWNERS / CONTRACTORS PROTECTIVE LIABILITY” blank spaces.
- E. Automobile Liability Insurance may be provided which covers Bodily Injury and Property Damage in one (1) Combined Single Limit, or may be provided with separate minimum limits as shown on the Certificate of Insurance and specified in Article 11 of the Supplementary Conditions. The person signing the Certificate of Insurance should show which option the Contractor has selected by marking out the coverage that is not provided under the policies indicated.

1.2 CERTIFICATION

- A. Certification wording may not be changed without specific written approval from the Owner.
 - 1. “Riders” or other unsolicited attachments are not allowed as part of the *Certificate of Insurance* unless specifically requested in writing by the Owner, or specified as part of the requirements for this Project.

1.3 CAUTION

- A. The *Certificate of Insurance* is intended to be used for all Projects. The Contractor must provide all insurance specified in the Contract Documents for this Project, whether indicated on this form, or not. The Contractor must verify all insurance has been provided as required.
- B. The Owner and Professional and all of their agents and employees are included as additional insureds on the Contractor’s insurance.

END OF SECTION 006500

SECTION 007213 – GENERAL CONDITIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General Conditions for this project shall be AIA Document A201, 2007 – General Conditions of the Contract for Construction. This document shall be made a part of the Contract Documents as if fully stated herein. Contractors are presumed to be familiar with this document; however a copy may be examined in the Architect's office.

END OF SECTION 007213

SECTION 007313 – SUPPLEMENTARY CONDITIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The following Supplementary Conditions modify the "General Conditions of the Contract for Construction," AIA Document A201, 2007. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect. In the event of a conflict between the General Conditions of the Contract for Construction and Section 007313, Section 007313 shall control even if the conflicting provision in the General Conditions of the Contract for Construction is not expressly revised or deleted by reference in Section 007313.
- B. The General Conditions may also be supplemented or amplified elsewhere in the Contract Documents by provisions located in, but not necessarily limited to, Division 01 of the Specifications.

1.2 SUPPLEMENTS

ARTICLE 1 – GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

- 1.1.1 Delete the last sentence in Article 1.1.1 and insert the following:

The Contract Documents shall include the Instructions to Bidders, plans, the Project Manual, including Division 00 and the specifications, Divisions 01 through 32, all Addenda and modifications to the plans and/or specifications, the Agreement between Owner and Contractor, the performance and payment bonds, the notice to proceed and any executed change orders. Information and documentation pertaining to soil investigation data, laboratory investigations, soil borings and related information included herein are not part of the Contract Documents. In the event of a conflict between the provisions of Division 00 and any other section of the Contract Documents, such other sections(s) shall govern.

1.1.5 THE DRAWINGS

- 1.1.5 Add the following to the end of Article 1.1.5:

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

1.1.9 MISCELLANEOUS DEFINITIONS

- 1.1.9 Add the following Article 1.1.9:

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

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

1.2.4 Add the following to the end of Article 1.2.4:

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

1.2.5 Add the following to the end of Article 1.2.5:

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

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

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

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

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

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

1.6 TRANSMISSION OF DATA IN DIGITAL FORMAT

1.6 Delete the phrase "they shall endeavor to" in the second line and insert the phrase "the Professional shall" and add the following to the end of the sentence:

..., which protocols shall be the same as or similar to the Digital Data Protocol Exhibit, AIA Doc. E201, 2007."

ARTICLE 2 – OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.2.1 Delete this subparagraph in its entirety.

2.2.2 Delete this subparagraph in its entirety.

2.2.3 Delete this subparagraph in its entirety.

2.3 OWNER'S RIGHT TO STOP THE WORK

2.3 Delete this subparagraph in its entirety and insert the following:

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

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

2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

2.4 Delete this subparagraph in its entirety and insert the following:

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails, within a seven (7) day period, after receipt of written notice from the Owner, to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies without further notice to the Contractor and/or its Surety. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Professional's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Professional. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor or its Surety shall pay the difference to the Owner.

ARTICLE 3 – CONTRACTOR

3.1 GENERAL

3.1.1 Add the following at the end of Article 3.1.1:

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

3.4 LABOR AND MATERIALS

3.4.2 Add the following to the end of Article 3.4.2:

Some Sections of the Specifications do not allow substitution of materials, products or equipment. Where "or equal" substitution is allowed the request for substitution will only be considered if made in strict accordance with the requirements of Article 3.4.4 and Section 002113 – Instructions to Bidders.

3.4.4 Add the following Article 3.4.4.

After the Contract has been executed, the Owner and the Professional may consider a request for the substitution of products in place of those specified only under the conditions set forth in the Project Specifications.

By making requests for substitutions, the Contractor:

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

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

3.4.5 Add the following Article 3.4.5:

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

3.4.6 Add the following Article 3.4.6:

E-Verification: Contractor represents and warrants that it will ensure its compliance with the Mississippi Employment Protection Act (Senate Bill 2988 from the 2008 Regular Legislative Session) and will register and participate in the status verification system for all newly hired employees. The term "employee" as used herein means any person that is hired to perform work within the State of Mississippi. As used herein, "status verification system" means the Illegal Immigration Reform and Immigration Responsibility Act of 1996 that is operated by the United States Department of Homeland Security, also known as the E-Verify Program, or any other successor electronic verification system replacing the E-Verify Program. Contractor agrees to maintain records of such compliance and, upon request of the State, to provide a copy of each such verification to the State. Contractor further represents and warrants that any person assigned to perform services hereunder meets the employment eligibility requirements of all immigration laws of the State of Mississippi. Contractor understands and agrees that any breach of these warranties may subject Contractor to the following: (a) termination of this Agreement

and ineligibility for any state or public contract in Mississippi for up to three (3) years with notice of such cancellation/termination being made public, or (b) the loss of any license, permit, certification or other document granted to Contractor by an agency, department or governmental entity for the right to do business in Mississippi for up to one (1) year, or (c) both. In the event of such termination/cancellation, Contractor would also be liable for any additional costs incurred by the State due to contract cancellation or loss of license or permit. See E-Verification / Good Faith Compliance attached.

3.7 PERMITS, FEES AND NOTICES

3.7.1 Delete Article 3.7.1 entirely and insert the following:

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

3.7.3 Delete Article 3.7.3 and insert the following:

At no additional cost to the Owner, the Contractor shall comply with all laws, statutes, ordinances, building codes, rules, and regulations of whatever nature that applies to the Project, whether enacted or adopted before or after bid opening. If the Contractor observes that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Professional and Owner in writing, and necessary changes shall be accomplished by appropriate modification. The Professional shall not administer the Contractor's safety performance, or any other matter relating to Contractor's means, methods, techniques, sequences and procedures, which are not a part of Contractor's scope of Work which is to be administered by the Professional as part of the Professional's obligations.

3.8 ALLOWANCES

3.8.2.3 Add the following to the end of Article 3.8.2.3;

Except when installation is specified as part of the allowance in the General Requirements (Division 01 of the specifications).

3.9 SUPERINTENDENT

3.9.1 Add the following to the end of Article 3.9.1.

The superintendent shall be designated by the Contractor at the preconstruction conference. After Owner's approval of such superintendent, he shall not be replaced by the Contractor without the Owner's prior written consent, which consent is required unless the Contractor submits proof satisfactory to the Owner that the superintendent should be terminated by the Contractor for cause.

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

3.10.3 Delete Article 3.10.3 and insert the following:

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

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.6 Delete Article 3.12.6 and insert the following:

By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor thereby represents that the Contractor has determined and verified all dimensions, quantities, field dimensions, relationships to existing Work, coordinated with Work to be installed later, coordinated with information on previously accepted shop drawings, Product Data, Samples, and similar submittals and verified compliance with all requirements of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor. In reviewing Shop Drawings, Product Data, Samples and similar submittals the Professional shall be entitled to rely upon the Contractor's representation that such information is correct and accurate.

3.12.8 Add the following to the end of Article 3.12.8:

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

3.12.9 Add the following to the end of Article 3.12.9:

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

3.18 INDEMNIFICATION

3.18.1 Modify Article 3.18.1 with the following:

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

ARTICLE 4 – ADMINISTRATION OF THE CONTRACT

4.1 PROFESSIONAL

4.1.1 Add the following at the end of this subparagraph:

The terms "Architect", "Professional", "Engineer" or "Design Professional" as used in the Contract Documents refers to the Engineering Resource Group, Inc., 350 Edgewood Terrace Drive, Jackson, MS 39206; Phone: (601) 362-3552; Fax: (601) 366-6418.

4.2 PROFESSIONAL'S ADMINISTRATION OF THE CONTRACT

4.2.10 Delete this subparagraph in its entirety.

ARTICLE 5 – SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

- 5.2.1 Delete the phrase “Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract” from the first sentence of Article 5.2.1 and replace with the following:

“The Contractor, with its first Application for Payment and as a condition to the Owner’s obligation to make payments to Contractor under Article 9 of the General Conditions as supplemented herein...”

- 5.2.5 Add the following Article 5.2.5:

The Contractor’s unauthorized substitution of any subcontractor, supplier, person or entity previously listed by Contractor shall entitle the Owner to reject the work, materials or products furnished and require removal and replacement at no additional cost to the Owner.

ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTS

6.1 OWNER’S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

- 6.1.1 Delete Articles 6.1, 6.1.1, 6.1.2, 6.1.3, 6.1.4 entirely and insert the following new Article 6.1:

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

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

- 6.2.3 Delete Article 6.2.3 entirely.

ARTICLE 7 – CHANGES IN THE WORK

7.1 CHANGES

- 7.1.3 Add the following to the end of Article 7.1.3:

Except as permitted in Article 7.3, a change in the Contract Sum or the Contract Time shall only be accomplished by written change order. Therefore, the Contractor acknowledges that it is not entitled to a change in the Contract Sum or the Contract Time in the absence of a written Change

Order on the basis of the course of conduct or dealings between the parties, the Owner's express or implied acceptance of alterations or additions to the Work, the Owner has been unjustly enriched by the Contractor's Work or any other basis otherwise allowed by law or the facts and Contractor agrees that any such extra or changed work was performed by it as a volunteer.

7.2 CHANGE ORDERS

7.2.2 Add the following Article 7.2.2:

Contractor's execution of a change order constitutes a final settlement to the Contract Sum and construction schedule and the Contract Time for all matters relating to or arising out of the change in the Work that is the subject of the change order including, but not limited to, all direct and indirect costs associated with such change, all extended direct job site and home office overhead costs and any and all delay and impact cost for the change, whether alone or in combination with other changes, including any impact, ripple or cumulative effect resulting therefrom, if any.

7.2.4 Add the following Article 7.2.4.:

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

7.3 CONSTRUCTION CHANGE DIRECTIVES

7.3.7 Modify Article 7.3.7 to the following:

In the first sentence, delete the words "a reasonable amount" and substitute "a reasonable allowance for the combined overhead and profit in accordance with subparagraph 7.3.11 below." Delete Sections 7.3.7.4 and 7.3.7.5 entirely.

7.3.8 Delete the first sentence and insert the following:

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

7.3.11 Add the following Article 7.3.11:

The allowance for overhead, taxes, fees, bonds, insurance and profit attributable to a change included in the total cost to the Owner shall be based on the following schedule. The overhead includes general home office, field personnel, superintendents, labor burden and all costs attributable to field and office personnel.

1. For the Contractor, for work performed by the Contractor's own forces, 16 percent of the cost.
2. For the Contractor, for work performed by the Contractor's subcontractor, 10 percent of the amount due the sub-contractor.
3. For each sub-contractor or sub-subcontractor involved, for work performed by that subcontractor's or sub-subcontractor's own forces, 16 percent of the cost.
4. For each subcontractor, for work performed by the subcontractor's sub-subcontractor's, 10 percent of the amount due the sub-subcontractor.
5. Costs to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.7.

ARTICLE 8 – TIME

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.1 Delete Article 8.3.1 and Insert the following:

If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Professional, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by fire, natural disasters, unavoidable casualties beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Professional determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Professional may determine.

8.3.3 Add the following to the end of Article 8.3.3:

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

8.3.4 Add the following Article 8.3.4:

Any claims by the Contractor for an increase in the Contract Time must follow the procedures set forth in Articles 15.1.2, 15.1.5 and 15.2, including the requirement that the Contractor give written notice of any claim within twenty-one (21) days after occurrence of the event giving rise to such claim or within twenty-one (21) days after the claimant first recognizes the condition giving rise to the claim, whichever is later.

8.3.5 Add the following Article 8.3.5:

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

8.3.6 Add the following Article 8.3.6:

Weather Delays: The Contractor agrees that normal weather occurrences and disruption to construction activities are included in the schedule. Weather occurrences or delays beyond normal are defined as days beyond the NOAA average for this area. Impacted days may be determined by the occurrence of weather events (precipitation > = 0.10inch) that occurred in excess of the average as indicated by NOAA.

The table below defines the monthly anticipated adverse weather days for the contract period and is based upon the NOAA Summary for this area.

7	January	7	April	6	July	5	October
7	February	8	May	5	August	6	November
7	March	6	June	4	September	8	December

The Contractor is responsible for providing the NOAA data as stated above and the observed deviation in excess of the average as defined by the table above. The weather data is to be received monthly with the Application for Payment.

All requests for time extensions shall be made monthly in writing with the Application for Payment. No monetary change in the contract value is considered due to impacted days. The Owner reserves the right to review any requests for consideration of value for extenuating circumstances by the Contractor in regard to schedule and value. The Owner is not obligated under this review for additional compensation as per Article 15.1.5.2.

ARTICLE 9 – PAYMENTS AND COMPLETION

9.3 APPLICATION FOR PAYMENTS

9.3.1 Add the following to the end of Article 9.3.1:

The Form of Application for Payment will be AIA Document G702, Application and Certification for Payment supported with AIA Document G702A, Continuation Sheet.

9.3.1.3 Add the following Article 9.3.1.3:

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

9.3.2.1 Add the following Article 9.3.2.1:

Payment on materials stored at some location other than the building site may be approved by the Professional and the Owner after the Contractor has submitted the following items:

1. An acceptable Lease Agreement between the General Contractor and the owner of the land, or building, where the materials are stored covering the specific area where the materials are located.
2. Consent of Surety or other acceptable bond to cover the materials stored off-site.
3. All Perils Insurance coverage for the full value of the materials stored off-site.
4. A Bill of Sale from the Manufacturer to the General Contractor for the stored materials.
5. A complete list and inventory of materials manufactured stored and delivered to the storage site and of materials removed from the storage site and delivered to the job site.
6. A review by the Professional of the materials stored off-site prior to release of payment.
7. Proof of payment of stored materials verified by the supplier must be submitted to the Professional within thirty (30) days of the Application for Payment on which payment for said material was made. If proof of payment is not submitted within thirty (30) days, then payment for said materials will be deducted from the next application for payment and withheld until proof of payment is received.

9.3.2.2 Add the following Article 9.3.2.2:

Affidavit Certifying Payment to All Subcontractors

1. Submit to the Owner, an Affidavit Certifying Payment to All Subcontractors on a monthly basis after the submittal, approval and payment of Application for Payment #1.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

- 9.5.1.7 Delete the word "failure".

9.6 PROGRESS PAYMENTS

- 9.6.1 Delete Article 9.6.1 and insert the following:

Subject to the conditions of the Contract, the Owner shall make payment to the Contractor in the amount certified within forty-five (45) days after receipt of the Certificate for Payment from the Professional. Payment shall not be considered late until forty-five (45) days after Owner's receipt of the approved Certificate for Payment from the Professional.

- 9.6.1.1 Add the following Article 9.6.1.1:

Contractor's Applications for Payment shall be submitted on or before the 15th day of each month. Any application not submitted on or before this date may not be processed or approved until the following month.

- 9.6.7 Add the following to the end of Article 9.6.7:

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

9.7 FAILURE OF PAYMENT

- 9.7.1 In the first sentence, delete the words "or awarded by binding dispute resolution".

9.8 SUBSTANTIAL COMPLETION

- 9.8.1 Delete this subparagraph in its entirety and insert the following:

Substantial completion for purposes of this Contract occurs only upon Contractor's compliance with the following conditions precedent: (a) the Contractor furnishes to the Professional all close-out documents required by the Contract Documents in a form satisfactory to the Professional and the Owner, (b) the Contractor furnishes the manufacturers' certifications required by the Contract Documents; (c) the Contractor furnishes the Guarantee of Work required by Section 00 73 13, Paragraphs 12.2.2.1.1; and (d) the Professional certifies that the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose.

- 9.8.2.1 Add the following Article 9.8.2.1:

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

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

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

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

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

- 9.8.5 Add the following to the end of Article 9.8.5:

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

- 9.8.6 Add the following Article 9.8.6:

The costs of inspections requested by Contractor and made by Professional which are not required by Articles 4, 9.8, 9.10.1 or 12 of the General Conditions and any other inspection required by Article 12 other than the year-end inspection itself, will be the responsibility of the Contractor and will be deducted by the Owner from the Application for Payment submitted after the Owner's receipt of the Professional's statement for its costs of additional inspections. These costs are not the result of Contractor's failure to timely complete the Contract within the specified time and, therefore, such costs are in addition to and not a part of any liquidated damages calculation, if any.

- 9.8.7 Add the following Article 9.8.7:

Upon the Owner's acceptance of the Work as substantially complete and upon Contractor's compliance with all conditions precedent to substantial completion as stated in Section 00 73 13, Paragraph 9.8.1 and upon application by the Contractor, the Owner will pay to the Contractor all retainage held by the Owner less an amount equal to the greater of (a) two percent (2%) of the Contract sum, or (b) two hundred percent (200%) of the estimated cost of the Work remaining to be performed by the Contractor in accordance with the Professional's determination. Final payment, including all retainage, shall be made at the time and in the manner provided for final payment in accordance with the provisions of Article 9.10 and the additional conditions precedent to final acceptance / payment set forth in Section 00 73 13, Paragraphs 9.8.5 and 9.10.

- 9.9 PARTIAL OCCUPANCY OR USE

- 9.9.1.2 Add the following new subparagraph:

The Owner's occupancy or use of any completed or partially completed portions of the Work shall not affect Contractor's obligation to complete incomplete items on the list attached to the Certificate of Substantial Completion within the time fixed in the Certificate and does not waive

Owner's right to obtain completion of incomplete items at Contractor's expense upon Contractor's failure to timely complete same.

9.10 FINAL COMPLETION AND FINAL PAYMENT

9.10.2.1 Add the following Article 9.10.2.1:

Final acceptance / completion for purposes of this Contract occurs only upon Contractor's compliance with the following conditions precedent: (a) The Contractor furnishes to the Professional all required close-out documents in a form satisfactory to the Professional and the Owner; (b) the Contractor furnishes all required manufacturers' certifications (c) the Contractor furnishes the signed Guarantee of Work required by Section 00 73 13, Paragraph 12.2.2.1.1; (d) the Professional certifies final acceptance / completion of the Project through issuance of a "Certificate of Final Completion".

9.11 LIQUIDATED DAMAGES

9.11.1 Add Section 9.11 LIQUIDATED DAMAGES and insert the following Article 9.11.1:

Time being of the essence of this Contract and a matter of material consideration thereof, a reasonable estimate in advance is established to cover losses incurred by the Owner if the project is not substantially complete on the date set forth in the Contract Documents. The Contractor and his Surety will be liable for and will pay the Owner the sums hereinafter stipulated as fixed and agreed as liquidated damages for each calendar day for delay until the Work is substantially complete. The Contractor and his Surety acknowledge that the Owner's losses caused by the Contractor's delay are not readily ascertainable and that the amount estimated per day for liquidated damages is reasonable and is not a penalty.

The amount established per day for liquidated damages is \$ 250.00.

ARTICLE 10 – SAFETY

10.1 Add the following to the end of Article 10.1:

The Professional shall not administer the Contractor's performance of Article 10 (including subparagraphs 10.1 through 10.4) because the initiation, maintenance and supervision of safety precautions and programs is the sole responsibility of the Contractor as means, methods, techniques, sequences and procedures of construction and, therefore, is not part of the Contractor's scope of Work which is to be administered by the Professional.

ARTICLE 11 – INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.1.5 Delete the words "other than the Work itself".

11.1.1.9 Add the following Article 11.1.1.9:

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

1. Premises - operations.
2. Independent Contractor's Protective.
3. Products and completed operations.

4. Contractual - including specified provisions for the Contractor's obligations under 3.18.
5. Owned, non-owned and hired motor vehicles.
6. Broad form coverage for property damage.
7. Owner and Professional will be listed as additional insureds on policy.

11.1.2 Delete Article 11.1.2 in its entirety and insert the following:

1. GENERAL LIABILITY	
Commercial General Liability (Including XCU)	
General Aggregate	\$2,000,000 Aggregate
Products & Completed Operations	\$2,000,000 Aggregate
Personal & Advertising Injury	\$1,000,000 per Occurrence
Bodily Injury & Property Damage	\$1,000,000 per Occurrence
Fire Damage Liability	\$500,000 per Occurrence
Medical Expense	\$10,000 per Person
2. OWNERS & CONTRACTORS PROTECTIVE LIABILITY	
Bodily Injury & Property Damage	\$2,000,000 Aggregate
Bodily Injury & Property Damage	\$1,000,000 per Occurrence
3. AUTOMOBILE LIABILITY	
(Owned, non-owned & hired vehicles)	
Contractor Insurance Option No. 1	
Bodily Injury & Property Damage (Combined Single Limit)	\$1,000,000 per Occurrence
Contractor Insurance Option No. 1	
Bodily Injury	\$500,000 per Person
Bodily Injury	\$1,000,000 per Accident
Property Damage	\$100,000 per Occurrence
4. EXCESS LIABILITY (UMBRELLA ON PROJECTS OVER \$500,000)	
Bodily Injury & Property Damage (Combined Single Limit)	\$2,000,000 Aggregate \$1,000,000 per Occurrence
5. WORKERS' COMPENSATION EMPLOYERS' LIABILITY (AS REQUIRED BY STATUTE)	
Accident	\$100,000 per Occurrence
Disease	\$500,000 Policy Limit
Disease	\$100,000 per Employee
6. PROPERTY INSURANCE	
Builder's Risk Or	\$ Equal to Value of Work
Installation Floater	\$ Equal to Value of Work
7. CONTRACTOR'S ERRORS & OMISSIONS AND POLLUTION LIABILITY	
Contractor's Errors & Omissions and pollution liability	\$1,000,000 per Occurrence
8. COMMERCIAL CONSTRUCTION UMBRELLA	
Commercial Umbrella Insurance	\$5,000,000

11.1.5 Add the following Article 11.1.5:

Furnish one copy of certificate herein required for each copy of the Agreement, specifically set forth evidence of all coverage required by Articles 11.1.1, 11.1.1.7 and 11.1.2. The form of the certificate will be AIA Document G705 or a similar form acceptable to Owner. Furnish to the Owner and Professional, copies of any endorsements that are subsequently issued amending coverage or limits. If the coverages are provided on a claims-made basis, the policy date or retroactive date shall predate the Contract and termination date of the policy or applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment.

11.2 OWNER'S LIABILITY INSURANCE

11.2 Delete Article 11.2 in its entirety and insert the following:

The Contractor will pay for and maintain such insurance as will protect the Owner and Professional from their contingent liability to others for damages because of bodily injury, including death, which may arise from operations under this Contract and other liability for damages which the Contractor is required to insure under any provision of this Contract. Certificate of this insurance shall be filed with the Owner and Professional and will be the same limits set forth in Article 11.1.2.

11.3 PROPERTY INSURANCE (BUILDERS' RISK OR INSTALLATION FLOATER)

11.3.1 Change the first line of the Article 11.3.1 to read as follows:

"The Contractor shall purchase...."

11.3.1 Add the following to the end of the paragraph:

Such property insurance shall be maintained, unless otherwise provided in the Contract Documents, or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made, as provided in Paragraph 9.10, or until no person or entity other than the Owner has an insurable interest in the property required by this Paragraph 11.3 to be covered, whichever is later.

11.3.1.2 Delete Article 11.3.1.2 in its entirety.

11.3.1.3 Delete Article 11.3.3 in its entirety and insert the following:

If the property insurance requires minimum deductibles and such deductibles are identified in the Contract Documents, the Contractor shall pay the deductible and all other costs not covered because of such deductibles. If the Contractor or insurer increases the required minimum deductibles above the amounts so identified or if the Contractor elects to purchase this insurance with voluntary deductible amounts, the Contractor shall be responsible for payment of the additional costs not covered because of such increased or voluntary deductibles. If deductibles are not identified in the Contract Documents, the Contractor shall pay the amount of the deductible and all costs not covered because of deductibles.

11.3.2 Delete this Subparagraph in its entirety.

11.3.3 Delete this Subparagraph in its entirety.

11.3.4 Delete this Subparagraph in its entirety.

11.3.5 Delete this Subparagraph in its entirety.

11.3.6 Delete this Subparagraph in its entirety.

11.3.10 Delete Article 11.3.10 in its entirety and insert the following:

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

11.5 OWNER'S AND PROFESSIONAL'S PROTECTION

11.5.1 Add Section 11.5 OWNER'S AND PROFESSIONAL'S PROTECTION and insert the following Article 11.5.1:

In addition to the above, the Contractor shall take out in the Owner's and Professional's names, and maintain during the same time period, Public Protective Liability Insurance and Property Damage Insurance in the amount of not less than \$1,000,000.000 combined single limit, which policies shall cover the operations of the Contractor, and those of his subcontractors to protect the Owner and Professional from loss. This protection shall not be considered as a separate policy by the Contractor, but shall be a rider to the Contractor's coverage.

ARTICLE 12 – UNCOVERING AND CORRECTION OF WORK

12.2.2.1 Add the following to the end of Article 12.2.2.1:

Prior to the end of the one-year period, the Professional may schedule a warranty inspection, which shall be attended by the Professional, the Owner, the Contractor and all major subcontractors. During this inspection, the parties shall identify all defective and/or nonconforming items and fix a time within which all defective and/or nonconforming items shall be repaired and/or replaced.

12.2.2.1.1 Add the following Article 12.2.2.1.1:

As a condition to Substantial Completion of the Work under Section 007313, Article 9.8.4, Contractor, upon completion of the Work, shall prepare and submit to the Owner a Guarantee of Work, sworn to by the Contractor, stating:

As required by Section 007313, Paragraphs 12.2.2.1.1 and 12.2.2.6, Contractor and Contractor's Surety hereby guarantee that all Work performed on the above captioned project is free from defective and/or nonconforming materials and workmanship and that for a period of one-year for construction, from the date of final completion or such longer period of time as may be called for in the Contract Documents for such portions of the Work, Contractor will repair and/or replace any defective and/or nonconforming materials and workmanship in accordance with the requirements of the Contract Documents.

12.2.6 Add the following Article 12.2.6:

Within the one-year period, if repairs or replacement are requested by Owner in connection with guaranteed Work which, in the opinion of the Owner, are rendered necessary as a result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the Contract Documents, the Contractor and/or its Surety shall promptly, upon receipt of notice from and without expense to the Owner, place in satisfactory condition in every particular, all such guaranteed Work, correct all defects therein and make good all damages to the building, site, equipment or contents thereof which, in the opinion of the Owner, are the result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the terms of the Contract Documents; and make good any work or materials or the equipment

and contents of said buildings or site disturbed in fulfilling any such guaranty. If, after notice or within the time agreed upon by the parties at the warranty inspection, the Contractor and/or its Surety fail to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected in accordance with Article 2.4 and the Contractor and his Surety shall be liable for all expenses incurred. All special guarantees applicable to definite parts of the Work stipulated in the Contract Documents shall be subject to the terms of this paragraph during the first year of the life of such special guarantee.

ARTICLE 13 – MISCELLANEOUS PROVISIONS

13.6 Delete this Article in its entirety and insert the following:

Payments due and unpaid under the Contract Documents shall bear interest as provided by Mississippi Code, Section 87-7-3.

ARTICLE 14 – TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

14.1.1.4 Delete Article 14.1.1.4 entirely.

14.2 TERMINATION BY THE OWNER FOR CAUSE

14.2.1.1 Delete the word “repeatedly” from Article 14.2.1.1.

14.2.1.3 Delete the word “repeatedly” from Article 14.2.1.3.

14.2.1.5 Add the following Articles 14.2.1.5 and 14.2.1.6:

5. fails to achieve substantial completion of the Project as described in Section 00 73 13, Article 9.8.5, within the time stated therein;
6. fails to meet any deadline required by the Contract. Contractor acknowledges that time is of the essence for this Contract and that all deadlines required by the Contract are critical to timely completion of the Contract. Therefore, Contractor agrees that its failure to meet any deadline constitutes a substantial and material breach of this Contract, entitling the Owner to terminate the Contract.

14.2.5 Add the following Article 14.2.5:

If the Owner terminates the Contract for cause, and it is determined for any reason that the Contractor was not actually in default under the Contract at the time of termination, the Contractor shall be entitled to recover from the Owner the same amount as the Contractor would be entitled to receive under a termination for convenience as provided by Article 14.4. The foregoing shall constitute the Contractor’s sole and exclusive remedy for termination of the Contract. In no event shall the Contractor be entitled to special, consequential, or exemplary damages, nor shall the Contractor be entitled to anticipated profits resulting from termination of this Contract.

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

14.4 Delete Articles 14.4.1, 14.4.2, and 14.4.3 entirely and insert the following:

- 14.4.1 The Owner may, without cause or fault of either the Contractor or the Owner, terminate the Contract in whole or in part if the Owner, in its sole discretion, determines it to be in the Owner's best interest.
- 14.4.2 Upon the Owner's termination for convenience, the Contractor shall only be entitled to payment as provided in Subparagraph 14.1.2.
- 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for reasonable profit and overhead on work performed. The Contractor shall not be entitled to receive any payment for either overhead or profit on work not performed.

ARTICLE 15 – CLAIMS AND DISPUTES

15.1.5 CLAIMS FOR ADDITIONAL TIME

15.1.5.2 Add the following to the end of Article 15.1.5.2:

“The Contractor must submit each month with his Application for Payment a separate letter stating that he is requesting an extension of time for abnormal adverse weather or that he has no claim for an extension for that period of time. Payment is not due on a monthly application until the letter is received. Complete justification, including weather reports, daily reports, correspondence and any other supporting data must be provided for each day for which an extension is requested. A letter or statement that the Contractor was delayed is not an adequate justification. The receipt of this request and data by the Professional will not be considered as Owner or Professional approval of a time extension in any way.”

- 15.2.1 Delete all references to mediation.
- 15.2.5 Delete the last sentence and its references to mediation.
- 15.2.6 Delete this paragraph in its entirety.
- 15.2.8 Delete this paragraph in its entirety.
- 15.3 Delete the entire paragraph entitled “MEDIATION”, including subparagraphs 15.3.1, 15.3.2, and 15.3.3.
- 15.4 ARBITRATION
- 15.4.1 Delete this paragraph in its entirety and add the following paragraph as follows:

The Owner shall have the sole option of selecting arbitration as the means for resolving the parties' dispute and the Contractor shall, before initiating any proceeding against the Owner, notify the Owner in writing that it intends to initiate legal proceedings against the Owner which notice shall include a description of the claim(s) and amount(s) thereof. Within ten (10) business days after receipt of such notice, the Owner shall advise the Contractor whether the dispute is to be arbitrated or litigated. If arbitration is selected by the Owner, then any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Sections 15.1.6, 9.10.4 and 9.10.5, shall, after decision by the Professional or 30 days after submission of the Claim to the Professional, be subject to arbitration If selected by the Owner at its sole and exclusive option,

15.4.1.1 Delete paragraph 15.4.1.1 in its entirety.

14.4.2 Delete this paragraph and substitute the following:

Claims shall be decided by arbitration, if selected by the Owner, which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect but not administered by the American Arbitration Association. The demand for arbitration shall be filed in writing with the other party to the Contract and with the American Arbitration Association if the arbitration is to be administered by the American Arbitration Association, and a copy shall be filed with the Professional.

15.4.3 Delete this paragraph and substitute the following:

If arbitration is selected by the Owner, a demand for arbitration shall be made within the time limits specified in Sections 4.4.6 and 4.6.1 as applicable, and in other cases within a reasonable time after the Claim has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations as determined pursuant to Section 13.7.

15.4.4 Delete Article 15.4.4 CONSOLIDATION OF JOINDER, including subparagraph 15.4.4.1, 15.4.4.2 and 15.4.4.3 in its entirety.

END OF SECTION 007313

SECTION 007314 – PROFESSIONAL’S SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 TERMINOLOGY

- A. Professional - Wherever the term or “Professional” is used in the specifications, it refers to Engineering Resource Group, Inc., 350 Edgewood Terrace Drive, Jackson, MS 39206, which is authorized to prepare all drawings, specifications, and details for this work, and to act as the Owner’s representative during construction.
- B. Owner: Wherever the term “Owner” is used in the specifications, it refers to Alliance Heath Center.
- C. Notice: The term “notice” as used herein shall mean and include all written notices, demands, instructions, claims, approvals, and disapprovals required to obtain compliance with contract requirements. Any written notice by either party to the contract shall be sufficiently given if delivered to or at the last known business address of the person, firm or corporation constituting the other part of the contract, or to his, their, or its duly authorized agent, representatives, or officer; or when enclosed in a postage prepaid envelope addressed to such last known business address and deposit in a United States mailbox.
- D. As Directed: The term “as directed,” where used in the specifications, shall mean according to instructions issued by the Professional.
- E. Approved - Acceptable - Satisfactory: The term “approved”, “acceptable,” and “satisfactory” when used in the specifications, shall mean approved by the Professional.

1.2 SCOPE OF WORK

- A. This section is the Professional's requirements for implementation of the construction requirements. See Section 007213 – General Conditions and Section 007313 – Supplementary Conditions.

1.3 CONSTRUCTION DOCUMENTS

- A. The drawings are intended to show the general arrangement of the work and are not intended to be scaled or to serve as shop drawings. Omission of details concerning local code requirements or proper or normal installations of equipment specified shall not be cause for additional charges or claims. The specifications and the drawings are intended to be in agreement with each other, and to be mutually explanatory. They are also intended to be complementary and any work or material called for by either shall be performed and/or furnished as if called for by both.
- B. Any discrepancies within the documents shall be brought to the attention of the Professional a minimum of 5 days before bids are received. After bids are received, any discrepancies will be as interpreted by the Professional and there will be no additional cost to the Owner for these discrepancies.
- C. All drawings and specifications are a part of the work to be coordinated by each trade. All subcontractors are responsible to review all of the documents and coordinate heights,

locations, clearances, with all of the drawings. Any discrepancies should be brought to the Architect's attention at least one week before the bid date.

1.4 GENERAL REQUIREMENTS

- A. All materials shall be maintained with the established construction laydown area as coordinated and agreed upon with the Owner and Engineer in advance.
- B. All construction materials must be submitted at one time for review and approval. It must include all materials to be provided and included in the Contractor's warranty and certifications with no exceptions or exclusions as indicated in the documents.

1.5 BUILDING CODE REQUIREMENTS

- A. All parts of building work under contract by General Contractor and other contractors or subcontractors shall be executed in compliance with building codes of governing bodies, such as State Codes and Regulations also, the National Electrical Code and NFPA Life Safety Code. These requirements shall take precedence over the Professional's specifications or plans wherever a conflict exists.

1.6 VERIFICATION OF DIMENSIONS

- A. Before starting the construction work, all measurements shall be checked by contractor against dimensions of the plans to insure the intent of the ground floor base dimensions. Differences shall be called to the attention of the Professional for adjustment.
- B. Prior to starting the project work, the mechanical contractor and general subcontractor shall field verify all dimensions and wall conditions prior to starting the work.
- C. Before ordering any materials or doing any work, each contractor shall verify the dimensions and shall be responsible for the accuracy of such dimensions as they affect the work. No extra compensation will be allowed on account of differences between the dimensions shown on the drawings and actual dimensions.
- D. Shop drawing dimensions shall be checked with the building conditions and Professional's drawings for correctness before submitting same for approval to the Professional.

1.7 ENGINEERING AND LAYOUT

- A. The Contractor shall provide competent engineering services to execute the work in accordance with the contract requirements. He shall verify the figures shown on the survey and working drawings before undertaking any construction work and shall be responsible for the accuracy of the finished work.
- B. The Owner has established or will establish, such general reference points as will in his judgment, enable the Contractor to proceed with the work. If the Contractor finds that any previously established reference points have been destroyed or displaced, he shall promptly notify the Owner.
- C. The Contractor shall protect and preserve the established benchmarks and monuments and shall make no change in locations without the written approval of the Owner. Any of them which may

be lost or destroyed or which require shifting because of necessary changes in grades or locations, shall be subject to prior approval by the Owner, be replaced and accurately located by the Contractor.

1.8 OWNER'S RIGHT TO EXPEDITE

- A. The Owner reserves the right to aid in expediting materials whenever it is necessary to maintain the building schedule but does not relieve the Contractor of any responsibility in securing materials.

1.9 CONTRACT COORDINATION

- A. Multiple contracts could be under way on site during the duration of this contract. Coordination and cooperation will be required to complete the work identified. The Contractor is required to coordinate with the Professional any work which would interfere with other activities on site.

1.10 EXPERIENCE VERIFICATION

- A. Immediately after receipt of bids, and upon notification of Owner and/or Professional, furnish the following information for evaluation by the Owner (the Owner reserves the right to evaluate the following information prior to award of contract:
 - 1. Similar Experience: Furnish a complete listing of completed project or on-going projects similar in size and scope to this project, listing complete names, addresses, and telephone numbers of Owners, cost of project, and year completed or anticipated to be completed.
 - 2. Office Staff: Furnish a complete listing of all office staff listing name, address, and title.
 - 3. Superintendent: Furnish a complete resume for the proposed project superintendent, listing previous experience as either Assistant Superintendent or Superintendent. Experience listing shall show scope of projects and proposed superintendent's duties on these projects.

1.11 WORKMANSHIP

- A. All work as described or required shall be executed in a neat, skillful manner, in accordance with the best recognized trade practice. Only competent workmen (including the superintendent) who work and perform their duties satisfactory shall be employed on the project, and when requested by the Professional or Owner's Officials, the Contractor shall discharge and shall not re-employ on the project, any person who commits trespass or who is, in the opinion of the Professional, dangerous, disorderly, insubordinate, incompetent, or otherwise objectionable.

1.12 EXISTING UTILITIES

- A. Existing structures, plantings, trees, utility lines, and building or landscaping systems, within the work area and outside the work area, which are to be retained unchanged, shall be protected from damage by the Contractor, prior to the start of construction. Any streets, roadways, sidewalks, grounds, plantings, trees, utility line, building or landscaping systems, or other property that are damaged, as a result of the Contract Work, shall be properly repaired or fully replaced by the Contractor to the full satisfaction of the Owner.

- B. All utility meters, valves, switches, etc. within the work area shall remain accessible to Owner's employees for the duration of the project.
- C. The Contractor shall take all precautions to protect all existing sewer manholes, sewer lines, and storm drains from be infiltrated by construction debris and eroded silt.
- D. Utility interruptions and Utility Connections planned as part of the Work shall be coordinated a minimum of ten (10) calendar days prior to interruption of service or occurrence of work. The Owner maintains the right to withhold authorization until it is practical for the work to occur. The Owner utility infrastructure cannot be shut down to make connections without prior notification to all affected Owners Properties and nearby.
- E. The Contractor shall notify the Engineer, the Owner, and the Hospital facility director to schedule for any work to occur outside of the established construction area in each phase. The Contractor will coordinate all access to other areas in advance with the Owner and the Architect at least 48 hours in advance.

1.13 UTILITIES, ELECTRICITY, GAS, WATER, FENCE

A. Renovations With-in Existing Buildings.

1. The Owner will not bill the Contractor for utilities unless the practice becomes abusive.

1.14 RESPONSIBILITY OF CONTRACTOR TO ACT IN EMERGENCY

- A. In case of an emergency which threatens loss or injury of property and/or safety of life, the Contractor shall act without previous instructions from the Owner, as the situation may warrant. He shall notify the Owner immediately thereafter. Any compensation claimed by the Contractor, together with substantiating documents in regard to expense, shall be submitted to the Owner within twenty-eight (28) consecutive calendar days after each occurrence and the amount of compensation shall be determined by the agreement or arbitration.

1.15 PROTECTION OF PROPERTY, SITE SAFETY AND PROTECTIVE MEASURES

- A. The Contractor shall at all times safeguard the Owner's property from injury or loss in connection with this contract. He shall at all times safeguard and protect his own work and that of adjacent property (as provided by law and the contract documents) from damage. All passageways, guard fences, lights and other facilities required for protection by state or municipal laws and regulations and local conditions must be provided and maintained.
- B. The owner will not be responsible for the safety of the Contractor's work, materials or equipment. Protection of the property within the contract work area both day and night shall be the responsibility of the Contractor. The Contractor shall provide a chain and lock for the security gate that can be "double locked" with a Contractor's furnished lock so that the Owner can have access to the job site during emergencies.
- C. Precaution shall be exercised at all times for the protection of persons (including employees) and property. The safety provisions of applicable laws, building and construction codes shall be observed. Machinery, equipment, and all hazards shall be guarded or eliminated in accordance with the safety provisions of the latest edition of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, to the extent that such provisions are not in contravention of applicable laws and codes.

- D. Organized safety measures shall be enforced on all construction work. Daily safety meetings shall be held by the Contractor prior to start of construction each day. The Contractor shall meet all applicable OSHA, and other Federal, State, and local agencies' codes and requirements regarding safety on and adjacent to the construction site.
- E. The Contractor shall provide the Owner with a copy of all accident reports for any occurrences on site.
- F. The Contractor shall provide protective devices such as signs, lights, barricades, covered walkways, signals, fences and etc., shall be utilized night and day to protect students and personnel on the campus. All temporary construction shall conform to or exceed the requirements of Chapter 33, Safeguards During Construction, of the IBC latest edition.
- G. Contractor shall install and maintain a chain link perimeter fence at the edge of designated lay down area and construction boundary. Lay down area shall be graded, fertilized and sodded to the limits of the construction area and maintained throughout the duration of the project.
 - 1. The perimeter fence shall be 6'-0" high with wind screen. Wind screen color shall be selected by Owner.

1.16 FIRE PROTECTION

- A. The General Contractor will provide general temporary fire protection as required.

1.17 RISK MANAGEMENT

- A. These procedures are intended to enhance occupants' safety, workers' safety, and reduce contractor's liability.
 - 1. Existing fire alarm systems in building must be protected by covering sensors that may cause activation by dirt, dust, smoke, heat or fumes generated by the Contractor's work.
 - 2. "Hot" work requires special attention to ensure safe working conditions and protection to both facilities and workers.
 - a. Fire Extinguisher.
 - b. Fire Watch.
 - 3. Failure to adhere to these procedures may result in a "stop work" order and/or being assessed a fire run fee by the local Fire Department for each emergency response the Fire Department makes as a result of the Contractor's work activating the fire alarm system.

1.18 EROSION CONTROL

- A. Proper precautions shall be taken by the General Contractor to prevent erosion of the job site and run off from the job site. Precautions shall be taken during construction to prevent mud and debris being transported off the site onto the streets and drives. The Contractor shall repair any eroded areas at the end of the job, and wash streets and parking lots as needed, during the job, to keep them clear of soil, gravel or other material.
- B. Contractor shall provide, install and maintain erosion control methods to insure compliance with Mississippi Department of Environmental Quality (MDEQ) requirements. Contractor is responsible for application and approval of MDEQ.

1.19 USE OF PREMISES

- A. The Contractor expressly undertakes at his own expense:
 - 1. To store his apparatus, materials, supplies, and equipment in such orderly fashion at the site of the work as will not unduly interfere with the progress of his work or the work of any other contractors.
 - 2. To place upon the work, or any part thereof, only such loads as are consistent with the safety of that portion of the work.
 - 3. To affect all cutting, fitting, or patching of his work required to make the same conform to the plans and specifications, and except with the consent of the Professional not to cut or otherwise alter the work of any other contractor.
 - 4. Before final payment to remove all surplus material, false-work, construction sign, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations and to put the site in a neat, orderly condition, to thoroughly clean and leave reasonable dust free all finished surfaces on the interior of the building included in the contract; and to wash and polish all glass installed under the contract including the removal of all paint spatters and other defacement.
- B. All materials and equipment shall be brought onto the site by making use of such roadways and drives as designated by the Owner and across the grounds along routes established by the Owner. Access shall be confirmed in the pre-construction meeting.
- C. Any streets, roadways, sidewalks, grounds, plantings, trees or other property that may be damaged as a result of the contract work shall be properly repaired or fully replaced by the Contractor to the full satisfaction of all interests involved. Trenches cut across roads, streets, drives, and parking lots shall be back-filled, compacted and topped with an acceptable assembly of paving material to match existing paving material. The Owner must approve final paving patch assemblies. Patching asphalt and brick surfaces with concrete is not acceptable.

1.20 TRASH DISPOSAL AND BURNING

- A. From the very start of the work, until its entire completion, the Contractor shall keep on hand an adequate crew of laborers, or others to keep the entire building and surrounding street, sidewalks, alleys, etc. free from any dirt, rubbish and debris resulting from the execution of the contract. The Contractor is responsible for keeping the project site clean and litter-free on a daily basis. It shall be the responsibility of each individual prime contractor to provide dumpsters to collect and remove all of their related debris from the building and the sites. Contractor must take necessary precautions to protect asphalt surfaces and concrete surfaces from damage caused by dumpster placement, storage, and retrieval. Contractor will be required to replace all damaged surfaces.
- B. Contractor's use of the Owner's dumpsters, trash cans and other construction dumpsters is strictly prohibited.
- C. There shall be no burning on properties of the Owner. All clearing and grubbing, debris, rubbish, trash and any other material which is subject to burning shall be removed and disposed of outside the limits of the Owner's property. It shall be the responsibility of the Contractor to acquire, maintain and pay for, if necessary, a disposal area.
- D. No materials of any sort shall be buried on the Owner's property.

1.21 DESIGNATION OF STORAGE AND WORKING AREA

- A. The exact boundaries of the area which may be used by the Contractor and subcontractors for the storage of materials and as a working area will be clearly defined in the contract documents. The contract will include the development of the complete work area and both the design and construction operations will be confined to this area.
- B. The Contractor shall confine his operations, and provide within the designated storage and work areas any required space for all Sub-Contractors. Any damage to the grounds and irrigation systems within the designated working area or storage area shall be repaired by the Contractor, and left at the completion of the Project, either in the same state as found to exist at the start of the work, or as shown on the Contract Documents. Such damage shall include repairs or replacement of turf, shrubs, trees, sidewalks, parking lots, existing drains, street surfaces, curbs, gutters, irrigation systems, and other property and building systems. Existing structures, plantings and trees within the work area which are to be retained unchanged shall be protected. The Contractor shall repair all rutted and disturbed ground areas with solid sod to match existing ground cover. Contractor shall water and maintain sod until final acceptance of the project. An inspection of grounds by the Owner shall be included in the final punch list to determine if the site has been properly restored.

1.22 DESIGNATION OF PARKING AREA

- A. Parking for the Contractor's and Sub-Contractors' employees shall be close distance to the Project site. If sufficient parking area is not available within the designated storage and working area for the vehicles of workmen employed on the building, the Contractor shall require workmen to park their vehicles in areas designated by the Owner and instructed through the Owner's Representative.

1.23 TREES AND PLANTING

- A. Trees and plantings within the work area shall be protected by a 6 feet high (minimum) chain-linked construction fence located 15 feet beyond the drip line of the trees or plantings, at all times. Plastic construction fencing is not acceptable.
- B. Compaction equipment, vehicle parking, and storage of materials shall not be allowed beneath the drip line, in order to prevent damage to existing planting. Special exceptions must be approved by the Owner.
- C. The Contractor shall refer to the Mississippi Extension Service's publication, "Tree Protection Standards in Construction Sites" for further information and requirements not noted in this document.

1.24 WORK HOURS AND NON-INTERFERENCE OF OWNER'S OPERATIONS

- A. As a result of the Work involved, it is understood that the Contractor shall schedule and perform the Work in such a manner as to not unnecessarily interfere with the Owner's normal operations, including the interruption of utilities, without a minimum of ten (10) calendar days prior notice to the Design Professional and the Owner's Representatives.
- B. The Contractor expressly undertakes, at his own expense, to comply with the regulations governing the operations of the premises which are occupied by the Project, and to perform his contract in such a manner as not to interrupt or interfere with the operations of the Owner and to

perform any Work after normal working hours, or on Saturday, or on regular holidays without additional expense to the Owner.

- C. Construction is not permitted on Sundays, except by specific permission from the Owner.

1.25 IDENTIFICATION OF CONSTRUCTION WORKERS

- A. All construction workers and vendors shall wear, at all times, on their upper torso an identification badge, with their photograph, as issued by either their company or as acceptable to the Owner. The ID badge shall identify the name of the worker and the company by which the worker is employed.

1.26 WORKER CONDUCT – OBJECTIONABLE WORKMEN

- A. Any workman who may, because of improper conduct, become objectionable to the Owner will be promptly removed by the Contractor at the request of the proper Owner's officials. In addition, the following work requirements shall be met at all times:
 1. No firearms of any kind shall be allowed at the building. Possession of a firearm on the site shall be considered improper conduct.
 2. The possession or consumption of alcoholic beverages is forbidden on the Owner's properties, and shall be considered improper conduct.
 3. The use of tobacco products is prohibited in the renovated building. Smoking is prohibited at all times and at all locations in the building; including all Owner's facilities, properties and grounds. All violators will be subject to a fine in an amount set at the current rate according to Owner's Policy at the time of the offence. Fines will be assessed to the workers' company. Multiple violations shall be considered improper conduct.
 4. Clothing for construction workers shall conform to the accepted standards within the construction industry. This includes appropriate footwear, shirts, and pants. The provision of protective clothing shall be the responsibility of the General Contractor.
 5. Shirts and pants will be worn by all workers at all times. Non-compliance shall be considered improper conduct.
 6. Use of offensive language or gestures to any persons, or facility member, shall be considered improper conduct.
 7. Non-compliance with wearing of a company issued identification badge, with the worker's photograph, as noted under Identification of Construction Workers shall be considered improper conduct.

1.27 EXCAVATION

- A. Contractors shall follow all current conditions and procedures required by Mississippi One Call prior to and during excavations. No person shall make any excavation in any of the grounds without first obtaining a confirmation number from Mississippi One Call, Inc. calling 1-800-227-6477.
- B. The project site grounds as used herein include, but not limited to, the streets, sidewalks, parking areas, and all other public and private areas of the building, whether covered or uncovered.
- C. Safety dictates that Contractor be familiar with the color coding scheme used to mark the various utilities (blue – water; orange – gas, etc.).

- D. A copy of the Mississippi law Regulation of Excavations near underground utility facilities, and the uniform color code for marking underground utility lines are in Addendum D.
- E. Markings made by utility owners are valid for a period of ten (10) days from the proposed starting date provided to the Mississippi One Call, Inc. The person responsible for the excavation shall renew the notification with Mississippi One Call, Inc. at least two (2) days prior to the expiration and continue to renew notification throughout the duration of the excavation. By calling Mississippi One Call, Inc. on the eighth (8th) day, the utility owners can remark utilities so excavation projects can go longer than ten (10) days without requiring the excavator to stop work.
- F. Damage to utilities by excavators will be reported to Mississippi One Call, Inc. and the Owner immediately, especially damage to underground utilities permitting escape of any hazardous, flammable, toxic or corrosive gas or liquid. Additionally, those excavating shall take action as reasonably necessary to protect persons and property and to minimize hazards until arrival of the owner's personnel, police and/or fire department.
- G. Repairs to utilities are the responsibility of the excavator except where the excavator has fully complied with these procedures. The excavator shall be responsible for any costs and expenses incurred by the owner of the utilities in restoring, correcting, repairing, and replacing the damaged line or facility.
- H. Utility owners shall mark utilities within two (2) working days from the time Mississippi One Call, Inc. receives the notification.
 - 1. Unmarked locations – when an excavator sees evidence that utilities are unmarked, or encounters an unmarked utility, the excavator must immediately contact Mississippi One Call, Inc. and owners. All owners must contact the excavator within four (4) hours of any known underground utilities at the excavation site.

a. Group Identifying Colors for Utilities:

Color	Utility
Safety Red	Electrical
High Visibility Safety Yellow	Petroleum products: natural gas, oil, steam, gaseous materials
Safety Precaution Blue	Potable water, irrigation lines
Safety Green	Sewers and drain lines
High Visibility Pink	Temporary survey markings
White	Proposed excavation

- I. Procedures.
 - 1. Excavator calls Mississippi One Call, Inc. requesting utility locates and provides information requested.
 - 2. Mississippi One Call, Inc. notifies Owner's (Facilities Management, Telecommunication, Landscaping, etc.) and local providers. Each organization is responsible for marking their utilities.

- J. Excess Excavation: Any excess excavation shall be trucked to dumping points off the Project site, as directed by the Professional, or shown on drawings.

1.28 HARDWARE

- A. All finish hardware schedules are to be coordinated with the Owner for contact and procedures.
- B. The hardware schedule will be noted with sequential numbering system that is compatible with the existing sequence of doors in the facility. The sequence will be provided by the Owner prior to the submission of the hardware schedule.
- C. Door hardware shall be compatible with the existing Owner's systems. Keying and hardware schedules should be coordinated with the Owner's locksmith and with the building's manager.
- D. Construction cores shall be ordered and installed by the General Contractor to the extent required to secure the building. Final cores shall be provided by the Owner for installation by the General Contractor.
- E. The Owner may extend the times that Contractors may keep issued keys. If issued keys are returned within the specified time period, the key deposit will be refunded. If issued keys are not returned within the specified time period, the deposit will be forfeited.
- F. Any expenses that occur due to a Contractor losing a key will be borne by the Contractor. The contractor's Final Pay Request may be held until resolution of lost keys is reached.
- G. All building re-keying due to lost keys by Contractors will be performed and/or authorized by the Owner. Any duplication of Owner's keys is prohibited.
- H. For all questions regarding Owner's Hardware, Cores, and Keys, please contact the Owner.

1.29 CONSTRUCTION SIGN

- A. The Contractor shall not install any construction signs on the construction site.

1.30 FIRE ALARM SYSTEM RECORD OF COMPLETION

- A. A copy of the Fire Alarm System Record of Completion is to be completed and submitted to the Owner upon completion.

1.31 CONSTRUCTION CHANGE ORDERS

- A. See Supplementary Conditions Section of the Specifications, Article 7 – Changes in the Work for required procedures and allowable mark-ups.

1.32 NOTICE OF REVIEW TO THE OWNER

- A. The Owner must be notified minimum of (7) days prior to the need to review/approve any on-site mock-ups for color and/or details.

- B. The Owner shall require fourteen (14) calendar days to issue approvals of shop drawings, submittals, color schedules, sample selection, keying schedules, etc.; therefore, all such data should be submitted as soon as possible after a construction contract has been awarded. The designated review period shall be considered in the construction schedule.

1.33 SCHEDULING TESTING

- A. A representative of the Owner may wish to be present during periods of major testing: i.e., systems tests, performance tests, load tests, etc. The Owner must be notified a minimum of seven (7) days prior to the time when such tests are to be performed. Failure to issue such notice may result in repetition of the testing at the Contractor's expense. The presence of a representative of the Owner at such a test shall not preclude the Design Professional of his Owner review.

1.34 WITHHOLDING OF FINAL PAYMENT TO THE CONTRACTOR

- A. The Owner will withhold final payment of the Retainage to the Contractor until ALL project closeouts and as-builts are received in an acceptable manner per the Project Specifications.

1.35 COLOR SCHEDULE

- A. The Contractor shall furnish the necessary samples and chips from the actual suppliers or subcontractors for approval and color selection by the Architect. All colors available from the manufacturer shall be available for selection regardless of price codes or categories. (Actual color charts or physical samples shall be submitted for all color/finish selections. Scans or copies of color charts will not be accepted. Provide all information/color selection submittals at one time for finishes (interior & exterior) to be selected and coordinated with all finishes to be selected.)

1.36 CONTINUED OPERATION OF THE FACILITY

- A. All other existing spaces and utilities in and around the existing building must remain in operation during the construction period. In the event that utilities and/or heating/air conditioning systems must be disrupted, the Contractor shall provide prior notice of the time and duration of the cut-off to be approved by the Professional and Owner.
- B. Time and date of disruption of utilities and heating and air conditioning systems shall be agreed upon in advance by the Owner and the Professional in writing.
- C. The Contractor shall maintain and limit access to only those areas as indicated in the drawings and that have been designated by the Owner in advance and as per phasing indicated in the drawings. Use and access to other areas of these buildings is strictly prohibited.
- D. The Contractor shall notify the Professional of schedule for any work to occur outside of the established construction area. The Contractor will coordinate all access to other area in advance with the Owner's event schedule.
- E. The contractor shall maintain a clear path for exit and entrance to the existing facilities at all times during the project construction. Strictly follow the phasing schedule as indicated in the drawings. There shall not be additional cost to the contract for phases of work to be performed after normal working hours and on weekends.

1.37 PROJECT SCHEDULE/CONSTRUCTION NOTES

- A. The project schedule as described in Section Progress Schedules shall be detailed and shall delineate each phase of the work as indicated in the drawings. (See Drawings for detailed phasing requirements.)
- B. During all phases of the work, the Contractor shall provide access to the Owner, staff and visitors at all times as coordinated with the Professional. The job superintendent must be in the construction area at all times in which work is being performed in this project. (The project manager and superintendent for the project shall be approved by the Professional/Owner before the beginning of construction.)
- C. Any changes to the work schedule, phasing, or scope of work shall be approved by the Owner in advance.
- D. It is the Contractor's responsibility to log in, document, and record the exact locations of all utilities as a part of the record documents and to document existing conditions uncovered during construction.
- E. During all roofing renovation work, the contractor shall provide protection against water, moisture, and dust infiltration on all interior spaces at all times during construction. Protect all interior finishes and furniture with plastic sheathing (40 mil min thickness) with taped joints. The contractor shall provide for a water-tight condition at the end of each working day. Any damage to interior finishes or building systems/enclosure due to water infiltration during construction shall be replaced/repaired to match specified finish at no cost to the Owner.
- F. The contractor shall pressure clean-out all roof drains in project areas to verify they are working properly prior to starting the project work.

END OF SECTION 007314

DIVISION 01

GENERAL REQUIREMENTS

SECTION 010200 – ALLOWANCES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Related Work Specified Elsewhere: Sections of Specifications as listed under Schedule of Allowances.
- B. Allowances for Products:
 - 1. Purchase products under each allowance as directed by the Professional.
 - 2. Amount of each allowance includes:
 - a. Net cost of product.
 - b. Delivery and unloading at site.
 - c. Applicable taxes.
 - 3. In addition to amounts of allowances, include in bid, for inclusion in Contract sum, Contractor's costs for:
 - a. Handling at site, including uncrating and storage.
 - b. Protection from elements and damage.
 - c. Labor, installation and finishing.
 - d. Other expenses required to complete installation.
 - e. Overhead and profit.
- C. Selection of Products:
 - 1. Architect's Duties: Consult with Contractor in consideration of products and Suppliers; make selections, designate products to be used; and, notify Contractor in writing.
 - 2. Contractor's Duties: Assist Professional in determining qualified Suppliers; obtain proposals from Suppliers when requested by the Professional; and, make appropriate recommendations for consideration of the Professional. Upon notification of selection, enter into Purchase Agreement with designated Supplier.
- D. Delivery: The Contractor is responsible for arranging all delivery and unloading and should promptly inspect products for damage or defects and submit claims for transportation damage.
- E. Installation: Comply with requirements of referenced specification section.
- F. Adjustment of Costs: Should actual purchase cost be more, or less, than the specified allowance amount, the Contract Sum will be adjusted by Change Order equal to the amount of the difference.

1.2 SCHEDULE OF ALLOWANCES

- A. No allowances are included in this project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010200

SECTION 010250 – SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Submit a Schedule of Values to the Professional at least ten (10) days prior to submitting the first Application for Payment. Upon the Professional's request, the Contractor will provide supportive data substantiating their correctness. Use Schedule of Values only as basis for Contractor's Application for Payment.
- B. Form of Submittal: Submit Schedule of Values on AIA Document G703, or computer generated form containing similar style, using Table of Contents of these Specifications as basis for format for listing costs of work for sections under Divisions 2-33. Identify each line item with number and title as listed in Table of Contents in these Specifications.
 - 1. Organize Schedule of Values as follows:
 - a. (Description of Organized Schedule of Values, as applicable).
- C. Preparing Schedule of Values:
 - 1. Itemize separate line item cost for each of the following general cost items: Performance and Payment Bonds, field supervision and layout, temporary facilities and controls.
 - 2. Itemize separate line item cost for work required by each Section of these Specifications. Break down installed cost with overhead and profit.
 - 3. For each line item which has installed value of more than \$20,000, break down costs to list major products for operations under each item, rounding figures to nearest dollar. Make sum of total costs of all items listed in Schedule equal to total Contract sum.
- D. Preparing Schedule of Unit Material Values:
 - 1. Submit separate Schedule of unit prices for materials to be stored on which progress payments will be made. Make form of submittal parallel to Schedule of Values with each line item identified same as line item in Schedule of Values. Include in unit prices only: cost of material, delivery, unloading at site, and sales tax.
 - 2. Make sure unit prices multiplied by quantities equal material cost of that item in Schedule of Values.
- E. Review and Resubmittal: After the Professional's review and approval, the Schedule of Values shall be reviewed and approved by the bonding company. A letter of approval from the bonding company approving the Schedule of Values shall accompany the final submittal of the Schedule of Values to the professional. Payment based on the Schedule of Values shall not be until all approvals are obtained. If requested, revise and resubmit Schedule of Values until approvals are obtained.
- F. Bonding Company Approval: The contractor must submittal the initial Schedule of Values to their bonding company for approval prior to submitting to the architect. A letter of approval from the bonding company must accompany the initial schedule of values.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010250

SECTION 010270 – APPLICATION FOR PAYMENT

PART 1 - GENERAL

1.1 SCOPE

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

1.2 APPLICATIONS FOR PAYMENT

- A. Format: Applications for Payments will be prepared on AIA forms G702 - Application and Certificate for Payment and G703 - Continuation Sheet; or, a computer generated form containing similar data may be used.
- B. Preparation of Application:
 - 1. Present required information in typewritten form.
 - 2. Execute certification by signature of authorized officer.
 - 3. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
 - 4. List each authorized Change Order as an extension on continuation sheet, listing Change Order number and dollar amount as for an original Item of Work.
 - 5. Prepare Application for Final Payment as specified in Section 017200 – Contract Closeout & Record Documents.
- C. Submittal Procedures:
 - 1. Submit five (5) copies of each Application for Payment
 - 2. Submit an updated construction schedule with each Application for Payment as described in Section 013100 – Progress Schedules.
 - 3. Submit requests for payment at intervals agreed upon by the Professional, Owner and Contractor.
 - 4. Submit requests to the Professional at agreed upon times, or as may be directed otherwise.
- D. Substantiating Data:
 - 1. Submit data justifying dollar amounts in question when such information is needed.
 - 2. Provide one (1) copy of the data with a cover letter for each submittal.
 - 3. Indicate the Application number, date and line item number and description.
- E. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

- F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Submittal schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Report of preconstruction conference.
 9. Certificates of insurance and insurance policies.
 10. Performance and payment bonds.
 11. Copies of building permits.
- G. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- H. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010270

SECTION 012800 – CHANGE ORDER PROCEDURES

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes the procedures for processing Change Orders by the Professional and the Contractor.

1.2 CHANGE ORDER PROCEDURES

- A. Change Proposed by Professional: The Professional may issue a Proposal Request to the Contractor which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications and a change in Contract Time for executing the change. The Contractor will prepare and submit an estimate within ten (10) days.
- B. Change Proposed by Contractor: The Contractor may propose a change by submitting a request for change to the Professional, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other Contractors. Document any requested substitutions in accordance with Section 01630 entitled Substitutions and Product Options.
- C. Contractor's Documentation:
 - 1. Maintain detailed records of Work completed on a time and material basis. Provide full information required for evaluation of proposed changes, and substantiate costs of changes in the Work.
 - 2. Document each quotation for a change in cost or time with sufficient data allowing evaluation of the quotation.
 - 3. Provide additional data to support computations:
 - a. Quantities of products, labor, and equipment
 - b. Taxes, insurance and bonds
 - c. Overhead and profit
 - d. Justification for any change in Contract Time
 - e. Credit for deletions from Contract, similarly documented
 - 4. Support each claim for additional costs, and for Work completed on a time and material basis, with additional information:
 - a. Origin and date of claim
 - b. Dates and times work was performed and by whom
 - c. Time records and wage rates paid
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
- D. Construction Change Directive: The Professional may issue a document, approved by the Owner, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. The document will describe changes in the Work, and will

designate method of determining any change in Contract Sum or Contract Time. The change in Work will be promptly executed.

- E. Format: The Professional will prepare three (3) originals of the Change Order.
- F. Types of Change Orders:
 - 1. Stipulated Sum Change Order: Based on Proposal Request and Contractor's fixed price quotation, or Contractor's request for a Change Order as approved by the Professional.
 - 2. Unit Price Change Order: For predetermined unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of work which are not predetermined, execute Work under a Construction Change Directive. Changes in Contract Sum or Contract Time will be computed as specified for Time and Material Change Order.
 - 3. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in the Standard Form of Agreement Between the Owner and the Contractor. The Professional will determine the change allowable in Contract Sum and Contract Time as provided in the Contract Documents. The Contractor shall maintain detailed records of Work accomplished on Time and Material basis and shall provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- G. Execution of Change Order: The Professional will issue Change Orders for signatures of parties as provided in the Standard Form of Agreement Between the Owner and the Contractor. Final execution of all Change Orders requires approval by the Owner.
- H. Correlation of Contractor Submittals: The Contract shall promptly revise Schedule of Values and the Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust time for other items of Work affected by the change and resubmit. Promptly enter changes in Project Record Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012800

SECTION 010300 – ALTERNATES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section describes the changes to be made under each alternate.
- B. General: The referenced Specification sections contain the pertinent requirements for materials and methods to achieve the work described herein. Coordinate related work and modify surrounding work, as required, to complete the Project under each alternate designated in the Contract.

1.2 DESCRIPTION OF ALTERNATES

- A. Refer to Section 019000 – Division One Supplement, for Project specific description of project Alternates.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010300

SECTION 010410 – PROJECT COORDINATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: To set forth procedures, conditions and responsibility for coordination of the total project.
- B. Project Coordinator: The General Contractor will designate one (1) Individual as Project Coordinator or Superintendent, as referred to in the General Conditions. Prior to beginning the Work, the name and qualifications will be submitted, in writing, to the Professional. Upon the approval of the Professional and the Owner, the Project Coordinator will remain until the Project is completed and cannot be removed during construction without the written consent of the Owner and the Professional.

1.2 DEFINITIONS

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

1.3 DUTIES OF PROJECT COORDINATION

- A. General.
 - 1. Coordination: Coordinate the work of all Subcontractors and Material Suppliers.
 - 2. Supervision: Supervise the activities of every phase of work taking place on the Project.
 - 3. Mechanical/Electrical: Take special care to coordinate and supervise the work of the plumbing, heating and cooling and electrical Subcontractors.
 - 4. Communication: Establish lines of authority and communication at the job site.
 - 5. Location: The Project Coordinator must be present on the job all of the time.
 - 6. Permits: Assist in obtaining building and special permits required for construction.
- B. Interpretations of Contract Documents.
 - 1. Consultation: Consult with Architects and Engineers to obtain interpretations.
 - 2. Assistance: Assist in resolution of any questions.
 - 3. Transmission: Transmit written interpretations to concerned parties.
- C. Cessation of Work: Stop all work not in accordance with the requirements of the Contract Documents.
- D. Division 01: Coordinate and assist in the preparation of all requirements of Division 01 and specifically as follows:
 - 1. Cutting and Patching: Supervise and control all cutting and patching of other trades' work.
 - 2. Project Meetings: Schedule and preside at all project meetings.
 - 3. Progress Schedules: Prepare and submit all construction schedules; supervise work to monitor compliance with schedules.

4. Shop Drawings, Product Data and Samples: Administer the processing of all submittals required by the Project Manual.
 5. Schedule of Values: Assist in preparation and be knowledgeable of each entry in the Schedule of Values.
 6. Testing Laboratory Services: Coordinate all required testing.
 7. Construction Facilities and Temporary Controls: Allocate, maintain and monitor all temporary facilities.
 8. Substitutions and Product Options: Administer the processing of all substitutions.
 9. Project Closeout: Conduct final inspections and assist in collection and preparation of closeout documents.
 10. Cleaning: Direct and execute a continuing cleaning program Throughout construction, requiring each trade to dispose their own debris.
 11. Project Record Documents: Maintain up-to-date project record documents.
 12. Safety Measures: Plan and enforce all safety requirements.
- E. Changes: Recommend and assist in the preparation of requests to the Professional for any changes in the Contract.
- F. Application for Payment: Assist in the preparation and be knowledgeable of each entry in the Application and Certificate for Payment.

1.4 SUBCONTRACTOR'S DUTIES

- A. General: The Subcontractor is responsible for coordinating and supervising employees in the work to be accomplished under their part of the Contract.
- B. Schedules: Conduct work to assure compliance with construction schedules.
- C. Suppliers: Transmit all instructions to Material Suppliers.
- D. Cooperation: Cooperate with the Project Coordinator and other Subcontractors.

1.5 OWNER-PURCHASED PRODUCTS

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

1.6 SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
- B. Key Personnel Names: Within 10 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses.

Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.7 GENERAL COORDINATION PROCEDURES

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

1.8 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 3. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 4. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 5. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 - d. Fan coil units and all associated components within mechanical closets.
 - e. See Mechanical & Plumbing specifications for other requirements.

6. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. See Electrical specifications for other requirements.
 7. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 8. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: DWG, Version 2018, operating in Microsoft Windows operating system.

1.9 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.

13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012800 – Change Order Procedures.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Software log with not less than the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010410

SECTION 010450 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 GENERAL DESCRIPTION

- A. Scope: To set forth broad, general conditions covering cutting and patching that applies to everyone and everything on the job.
- B. Execute cutting including excavating, fitting, or patching of work required to:
 - 1. Make several parts fit properly.
 - 2. Uncover work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to Contract requirements.
 - 5. Install specified work in existing construction.
- C. In addition to Contract requirements, upon Professional's written instructions:
 - 1. Uncover work for observation of covered work.
 - 2. Remove samples of installed materials for testing.
 - 3. Remove work to provide alteration of existing work.
- D. Do not cut or alter work of another Contractor without permission.
- E. Payment of Costs: Costs caused by ill-timed, or defective work, or work not conforming to Contract Documents will be borne by party responsible for ill-timed, defective work, or non-conforming work.

1.2 MATERIALS/PRODUCTS

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

1.3 EXECUTION

- A. Inspection: Inspect existing conditions of work, including elements subject to movement, or damage during cutting and patching.
- B. Preparation Prior to Cutting: Provide shoring, bracing and support, as required, to maintain structural integrity of the building. Provide protection for other portions of work and protection from the elements.
- C. Performance:
 - 1. Execute cutting and demolition by methods which prevent damage to other work and will provide surfaces to receive installation of repairs and new work.
 - 2. Execute excavating and backfilling by methods which prevent damage to other work and prevent settlement.

3. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.
4. Refinish entire surfaces, as necessary, to provide an even finish. Refinish continuous surfaces to the nearest intersection and assemblies entirely.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010450

SECTION 010500 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Work required under this section consists of all temporary construction facilities, services and related items to complete the work indicated on the drawings and described in the Project Manual.
- B. Standards:
 - 1. Conform to or exceed all temporary construction requirements stated in the current edition of the International Building Code.
 - 2. Refer to Article 10.1.1 in Section 007213 – General Conditions.
- C. Materials: All materials required by the Work of this section shall be as specified in the respective sections.

1.2 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.3 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

PART 2 - PRODUCTS

2.1 FACILITIES AND CONTROLS

- A. Access: The Prime General Contractor shall provide an adequate access and/or roads to the site of the structure, if required for the prosecution of work; and, should also provide and maintain at least one (1) temporary, or permanent, access to each working elevation to be permanently occupied.
- B. Hoisting Facilities: The Prime General Contractor shall be responsible for providing suitable capacity and hoisting facilities for all people and materials. The use of the hoisting facilities shall be by mutual agreement of the Prime General Contractor and the individual Contractor.
- C. Sanitation Facilities: The Prime General Contractor is responsible for furnishing adequate temporary toilet facilities on the job site.
- D. Drinking Water: The Prime General Contractor shall provide at all times sanitary drinking water facilities for all workmen on the job including ice, when required, and paper cups, etc..
- E. Fire Protection: The Prime General Contractor shall provide general temporary fire protection. Subcontractors will be responsible for their own.
- F. Storage: The Prime General Contractor shall coordinate the allocation of storage areas to the various Sub- contractors.
- G. Temporary Heat: The Prime General Contractor shall provide heat, fuel and services, as necessary, to protect all work from dampness and cold until final acceptance. If in the late stages of the construction, mechanical and electrical installations will permit, the mechanical and electrical facilities may be used to provide heat and ventilation. However, the Owner is saved harmless of any costs of operation or responsibility as to acceptance of mechanical and/or electrical installations.
- H. Utilities: The Prime General Contractor shall make arrangements for and furnish all water, electricity (lighting and power) and other utilities necessary for construction purposes. A written agreement must be reached on how all utilities (water and electricity) will be furnished and the rates the Contractor will be charged. A copy of the final agreement signed by the Contractor and MSU must be forwarded to MSU. If the written agreement is not filed with MSU, the Contractor waives all rights as to the rates charged. MSU will then determine all utility rates and assess the charges before final payment is rendered.
- I. Construction Site Fence:
 - 1. General
 - a. Site Enclosure Fence: The contractor is required to install a construction fence, as shown in the plans, to be maintained, as needed, throughout the duration of the project. The site enclosure fence should be kept in a manner that will prevent people and animals from easily entering the site except by entrance gates.
 - 1) Extent of Fence: As indicated on Drawings.
 - 2) Maintain security by limiting number of keys and restricting distribution to authorized personnel. Allow owner to interlock their lock as necessary.
 - 3) The Contractor shall call Mississippi One-Call System, Inc., before driving any posts for the fencing.

- 4) Signs shall not be posted on the fence system except: "Caution: Construction Area Authorized Personnel Only" signs may be installed at 50 foot intervals; safety related signs required by OSHA; and visitor site entry rules as required by the Contractor. Advertising signage is strictly prohibited.
- 5) The Contractor shall keep plant growth from around the base of the fence by either trimming or chemical treatment.
- 6) Fence shall be maintained for the duration of the project, and shall not be removed without the Owner's permission.

2. Fence Design and Materials

- a. The minimum height for all temporary fencing shall be 8 feet.
- b. The fencing shall be of galvanized 11-1/2 ga. chain-link construction with a minimum of 1-5/8" O.D. tubular steel posts and top rails, and bottom tension wire.
- c. Privacy netting to screen construction activities shall be used on all projects unless specified otherwise in the contract documents.
- d. Privacy screen material shall be vinyl coated polyester or polypropylene, 6' tall, green, seamed reinforced hems at all edges, and grommets a maximum of 24" on center, equal to U.S. Fence's Privacy/Windscreen netting.

3. Gates

- a. Limit entrance/exit to no more than two locations, unless otherwise approved by the Owner.
- b. Gates shall be a minimum of 12 feet in width to allow access for emergency vehicles.
- c. Where other transportation authorities need to review gate locations and operation, communication with those authorities will be coordinated through the Owner.
- d. Gates shall be closed and locked at all times the site is not occupied, unless otherwise directed by the Owner where emergency vehicle passage through the site is needed to access existing occupied buildings.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
 3. Drinking water and private toilet.
 4. Coffee machine and supplies.
 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

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

PART 3 - EXECUTION

3.1 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary parking areas for construction personnel.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 010640 – Execution.
- F. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- G. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.2 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 010100 – Summary of Work.
- C. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Storm water Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rains.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Barricades, Warning Signs, and Lights: Provide as indicated in the Contract Documents and comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.3 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.

- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use permanent HVAC system to control humidity.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.4 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017100 – Cleaning.

END OF SECTION 010500

SECTION 010630 – SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 PRODUCTS LIST

- A. Within thirty (30) days after the Contract has been signed, the Contractor will submit to the Professional five (5) copies of a complete list of all products proposed for installation.
- B. Tabulate the list by Specification sections.
- C. For products specified under reference standards, include with listing of each product:
 - 1. Name and address of Manufacturer.
 - 2. Trade name.
 - 3. Model, or catalog designation.
 - 4. Manufacturer's data.
 - 5. Performance and test data.
 - 6. Reference standards.

1.3 CONTRACTOR'S OPTIONS

- A. For products specified only by reference standards, select any product meeting product standards by any Manufacturer.
- B. For products specified by naming a minimum of three (3) products or Manufacturers, select any product and Manufacturer named.
- C. For product specified by naming one (1) or more products, but indicating the option of selecting equivalent products by stating "or equal" after specified product, Contractor must submit request, as required for substitution, for any product not specifically named.
- D. For products specified by naming only one (1) product and Manufacturer, an equivalent product will always be accepted if it is equal in all respects. The Contractor must submit a request for substitution as set forth in this Section.

1.4 SUBSTITUTIONS

- A. Professional will not consider requests for substitutions during bidding.
- B. Within thirty (30) days after the Contract has been signed, the Professional will consider formal requests from the Contractor for substitution of products in place of those specified. Submit five (5) copies of the request for substitutions. Include in the request:

1. Complete data substantiating compliance of proposed substitutions with Contract Documents.
 2. For products:
 - a. Product identification including Manufacturer's name and address.
 - b. Manufacturer's literature: Product description, performance and test data and reference standards.
 - c. Samples.
 - d. Name and address of similar products on which product was used and date of installation.
 3. For construction methods:
 - a. Detailed description of proposed method.
 - b. Drawings illustrating methods.
 4. Itemized comparison of proposed substitutions with product or method specified.
 5. Data relating to changes in construction schedule.
 6. Accurate cost data on proposed substitution in comparison with product or method specified.
- C. In making request for substitution, Contractor represents:
1. Proposed product, or method, has been investigated and determined that it is equal or superior in all respects to that specified.
 2. The same guarantee will be provided for substitutions as for product or method specified.
 3. Installation of accepted substitutions will be coordinated into the Work, making such changes required of work to be complete in all respects.
 4. All claims for additional costs related to substitution which consequently become apparent will be waived.
 5. Cost data is complete and includes all related costs under the Contract.
- D. Substitutions will not be considered if:
1. Indicated, or implied, on shop drawings or product data submittals without formal request submitted in accordance with this Section.
 2. Acceptance will require substantial revision of Contract Documents.
 3. In the Professional's judgment, the product, or material, is not equal.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010630

SECTION 010635 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product

request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Section 01340 "Shop Drawings, Products Data and Samples."
- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01340 "Shop Drawings, Products Data and Samples." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

- B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

- C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017200 – Contract Closeout & Record Documents.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2. **Manufacturer/Source:** Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 3. **Products:**
 - a. **Restricted List:** Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. **Nonrestricted List:** Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 4. **Manufacturers:**
 - a. **Restricted List:** Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. **Nonrestricted List:** Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 5. **Basis-of-Design Product:** Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. **Visual Matching Specification:** Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01630 "Substitution and Product Options" for proposal of product.
- D. **Visual Selection Specification:** Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. **Conditions for Consideration:** Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 010635

SECTION 010640 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Coordination of Owner-installed products.
 - 5. Protection of installed construction.
 - 6. Correction of the Work.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.

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 and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to 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 010410 – Project Coordination.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

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

3.4 FIELD ENGINEERING

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

3.5 INSTALLATION

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

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 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 010640

SECTION 010650 – STARTING OF SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

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

1.2 SUMMARY

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

1.3 STARTING SYSTEMS

- A. Coordinate Schedule for start-up of various equipment and systems.
- B. Notify Professional and Owner seven (7) days prior to start-up of each system.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
- D. Verify that tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of responsible Contractors' personnel in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require Manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.4 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of Substantial Completion.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut-down of each item of equipment at agreed-upon times, at designated location.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.5 INFORMATIONAL SUBMITTALS

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

1.6 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - 3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 - 4. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals and in PDF electronic file format on compact disc.

1.7 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.8 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.

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

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect, with at least seven days advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

END OF SECTION 010650

SECTION 010710 – CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 EXECUTION

- A. During Construction: Execute cleaning to Ensure that building, grounds and public properties are maintained free from accumulations of waste materials and rubbish. Wet down dry materials and rubbish to lay dust and prevent blowing dust. At reasonable intervals during progress of work, clean site and public properties and dispose of waste materials, debris and rubbish. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for substantial completion or occupancy. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights. Schedule cleaning operations so that dust or other contaminants resulting from cleaning process will not fall on wet or newly painted surfaces.
- B. Final Cleaning: Employ experienced workmen, or professional cleaners, for final cleaning. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces and concealed spaces. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed finishes. Repair, patch and touch up marred surfaces to specified finish to match adjacent surfaces. Broom clean paved surfaces; rake clean other surfaces of grounds. Replace air conditioning filters if units were operated during construction. Clean ducts, blowers and coils if air conditioning units were operated without filters during construction. Maintain cleaning until Project, or respective portions thereof, is occupied by Owner.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Remove snow and ice to provide safe access to building.
- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- h. Sweep concrete floors broom clean in unoccupied spaces.
- i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- k. Remove labels that are not permanent.
- l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- q. Leave Project clean and ready for occupancy.

END OF SECTION 010710

SECTION 012000 – PROJECT MEETINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Contractor's Responsibilities: The General Contractor will administer all progress meetings which include the following:
1. Prepare agenda
 2. Distribute written notice of meetings seven (7) days in advance
 3. Make physical arrangements for and presiding at the meetings
 4. Record minutes
 5. Distribute copies of the minutes to participants within four (4) days
- B. Pre-Construction Meeting: Owner will schedule a pre-construction meeting as soon as possible after the award of Contract and the issuance of a Notice to Proceed.
1. Attendance:
 - a. Owner
 - b. Professional and Consultants
 - c. General Contractor
 - d. Major Subcontractors, including mechanical and electrical
 - e. Representatives of governmental, or other regulatory agencies
 2. Minimum Agenda: (prepared by the General Contractor)
 - a. Distribute and discuss list of major Subcontractors and construction schedule
 - b. Critical work sequencing
 - c. Designation of responsible personnel
 - d. Procedures for maintaining record documents
 - e. Use of premises, including office and storage areas
 - f. Owner's requirements
 - g. Security procedures
 - h. Housekeeping procedures
 3. Utilities: A written agreement must be reached on how all utilities will be furnished and the rates the Contractor will be charged. This agreement should be resolved at this meeting. Refer to Section 010500 entitled Construction Facilities and Temporary Controls of this Project Manual for additional utility requirements.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.

- b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
 6. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- D. Progress Meetings: Owner will schedule regular meetings at the time of the pre-construction conference. Hold all meetings as progress of work dictates.
1. Attendance:
 - a. Owner
 - b. Professional and Consultants
 - c. General Contractor
 - d. Subcontractors, as pertinent to the agenda
 2. Minimum Agenda:
 - a. Review, approve minutes of the previous meeting
 - b. Review work progress since last meeting
 - c. Note field inspections, problems and decisions
 - d. Identify problems which impede planned progress
 - e. Review off-site fabrication problems
 - f. f. Revise construction schedule, as indicated
 - g. Plan progress during the next work period
 - h. Review proposed changes
 - i. Complete other current business

- E. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012000

SECTION 013100 – PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Special reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
1. Working electronic copy of schedule file, where indicated.
 2. PDF electronic file.
 3. Eight paper copies.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Site Condition Reports: Submit at time of discovery of differing conditions.
- E. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01200 "Project Meetings." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
 2. Verify availability of qualified personnel needed to develop and update schedule.
 3. Discuss constraints, including work stages and interim milestones.
 4. Review delivery dates for Owner-furnished products.
 5. Review schedule for work of Owner's separate contracts.
 6. Review submittal requirements and procedures.
 7. Review time required for review of submittals and resubmittals.
 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 9. Review time required for Project closeout and Owner startup procedures.
 10. Review and finalize list of construction activities to be included in schedule.
 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 21 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 15 days for completion of punch list items and final completion.
- C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
- E. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

- F. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. Approximate count of personnel at Project site.
 3. Equipment at Project site.
 4. Material deliveries.
 5. High and low temperatures and general weather conditions, including presence of rain or snow.
 6. Accidents.
 7. Meetings and significant decisions.
 8. Unusual events (see special reports).
 9. Stoppages, delays, shortages, and losses.

10. Emergency procedures.
11. Change Orders received and implemented.
12. Construction Change Directives received and implemented.
13. Services connected and disconnected.
14. Equipment or system tests and startups.
15. Partial completions and occupancies.

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

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within seven day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

END OF SECTION 013100

SECTION 013400 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 SUBMITTALS

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

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

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

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

- a. Shop drawing and product data submittals shall be transmitted to Architect in electronic (PDF) format using Submittal Exchange, a website service designed specifically for transmitting submittals between construction team members.
 - b. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
 - c. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
2. Procedures:
- a. Submittal Preparation - Contractor may use any or all of the following options:
 - 1) Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the Submittal Exchange website.
 - 2) Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format.
 - 3) Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
 - b. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
 - c. Contractor shall transmit each submittal to Architect using the Submittal Exchange website, www.submittalexchange.com.
 - d. Architect / Engineer review comments will be made available on the Submittal Exchange website for downloading. Contractor will receive email notice of completed review.
 - e. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
3. Costs:
- a. General Contractor shall include the full cost of Submittal Exchange project subscription in their proposal. This cost is included in the Contract Amount. Contact Submittal Exchange at 515-393-2245 to verify cost prior to bid.
 - b. At Contractor's option, training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 515-393-2245.
 - c. Internet Service and Equipment Requirements:
 - 1) Email address and Internet access at Contractor's main office.
 - 2) Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.
- E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

- G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. All submittals will be processed using the online services of Submittal Exchange.
 - 2. Retain one of first two subparagraphs below if required.
 - 3. Electronic submittals will be uploaded to Submittal Exchange as PDF electronic files.
 - a. Architect will upload annotated files to Submittal Exchange for action by the Contractor.
 - b. Contractor to coordinate filing and assembly of project Close Out Documents using Submittal Exchange Protocols and filing retrieval methods.
 - c. Access permission, file interface and naming protocols using Submittal Exchange will be established in the Pre-Construction Meeting.
 - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:

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

- E. Coordination Drawing Submittals: Comply with requirements specified in Section 010410 – Project Coordination.
- F. Contractor's Construction Schedule: Comply with requirements specified in Section 013100 – Progress Schedule.
- G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 010250 – Schedule of Values and Section 010270 – Applications for Payment.
- H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017200 – Contract Closeout & Record Documents.
- I. Maintenance Data: Comply with requirements specified herein.
- J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- L. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- M. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- P. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- Q. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- R. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- S. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- T. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- U. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017200 – Contract Closeout & Record Documents.
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013400

SECTION 017200 – CONTRACT CLOSEOUT & RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: The work required in this Section consists of the final inspections and the submission of all closeout documents and related items to complete the Work indicated on the Drawings and described in the Project Manual.
- B. All items required in subsequent Specifications Sections shall also be required in addition to all items described within this section.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections apply to this section.

1.3 SUBMITTALS

- A. the Contractor shall submit, through the Professional, the following copies of items required before final payment is made.
- B. Contract Closeout Documents: Submit two (2) hard copies and two (2) electronic copies.
- C. Project As-built Drawings: Submit one (1) hard copy and two (2) electronic copies.
- D. Project Record Documents: Submit two (2) electronic copies.

PART 2 - PRODUCTS

2.1 FINAL INSPECTIONS

- A. Contractor's Inspection: The Contractor shall perform a punch list of all work and confirm that all items have been corrected prior to requesting the Professional's inspection. When the Contractor considers the Work, or a portion thereof is substantially complete, the Contractor shall prepare and submit to the Professional a comprehensive list of items to be completed or corrected prior to final payment. All startup testing of systems; testing, adjusting, and balancing of systems; Owner training sessions, final cleaning and touchup painting must be complete prior to requesting the Professional's Inspection.
- B. Professional's Inspection: The Contractor shall make a written request for a final inspection to the Professional ten (10) days prior to the inspection. A list of any deficiencies, compiled by the Professional, will be corrected by the Contractor. If, in the Professional's judgment, the Project is not ready for a final inspection, the Professional may schedule another inspection and submit re-inspection cost to the Contractor. The Contractor shall complete the final punch list provided by the Professionals.

- C. Owner's Inspection: After the Professional has ascertained the Project to be ready, an Owner's inspection will be scheduled within ten (10) days thereafter. The Owner's punch list shall be included with the Professional's punch list in the Substantial Completion Certificate and completed within ten (10) days after the Owner's acceptance.
- D. Correction of Work Before Final Payment:
 - 1. The Contractor shall promptly remove from the Owner's premises all materials condemned for failure to conform to the Contract, whether incorporated in the Work or not, and the Contractor shall, at his own expense, replace such condemned materials with those conforming to the requirements of the Contract. Failure to remedy such defects after ten (10) days written notice will allow the Owner to make good such defects and such costs shall be deducted from the balance due the Contractor, or charged to the Contractor in the event no payment is due.

2.2 CONTRACT CLOSEOUT DOCUMENTS

- A. The Contractor shall facilitate a review meeting with the Owner and Professional prior to assembling the close-out documents for submission to review the content and organizational format. The Contractor shall submit the following:
 - 1. Request for Final Payment: AIA Document G702, current edition, completed in full or a computer generated form having similar data; with notary seal and signature.
 - 2. Consent of Surety Company to Final Payment: AIA Document G707, current edition, completed in full by the Bonding Company; with correct contract dates, notary seal and signature.
 - 3. Power of Attorney: Closeout documents should be accompanied by an appropriate Power of Attorney; with notary seal and signature.
 - 4. Release of Liens and Certification that All Bills Have Been Paid: AIA Document G706A, current edition, completed in full or a sworn statement and affidavit from the Contractor to the Owner stating that all bills for this job have been paid and that the Owner is released from any and all claims and/or damages; with notary seal and signature.
 - 5. Contractor's Affidavit of Payment of Debts and Claims: AIA Document G706, current edition, completed in full; with notary seal and signature.
 - 6. Affidavit Certifying Payment to All Subcontractors with notary seal and signature.
 - 7. Guarantee of Work: Sworn statement that all work is guaranteed against defects in materials and workmanship for one (1) year from date of Owner's Substantial Completion acceptance, except where specified for longer periods.
 - a. Provide a Guarantee from the General Contractor for the Project.
 - b. Provide a Guarantee from each Subcontractor for their scope of work.
 - c. Provide a comprehensive Warranties Reference List listing for each warranty the following information:
 - 1) Subcontractor name and contract information.
 - 2) Manufacturer name and contact information.
 - 3) Product description.
 - 4) Length of time for each warranty.
 - d. Provide the Warranties from each manufacturer.
 - e. Word the Guarantee as directed by the Professional and as acceptable to the Owner.
 - f. All guarantees and warranties shall be obtained in the Owner's name.

- g. Within the Guaranty period, if repairs or changes are requested in connection with guaranteed work which, in the opinion of the Owner, are rendered necessary as a result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the terms of the Contract, the Contractor shall promptly, upon receipt of notice from and without expense to the Owner, place in satisfactory condition building, site, equipment or contents thereof. The Contractor shall make good any work, materials, equipment or contents of said buildings or site that may be disturbed by fulfilling any such Guaranty.
- h. If, after notice, the Contractor fails to proceed promptly to comply with the terms of the Guaranty, the Owner may have the defects corrected and the Contractor and his Sureties shall be liable for all expense incurred.
- i. All special guarantees applicable to definite parts of the work stipulated in the Project Manual or other documents forming part of the Contract shall be subject to the terms of this paragraph during the first year of the life of such special guaranty.

2.3 PROJECT AS-BUILT DOCUMENTS

- A. Project AS-BUILT Drawings: Submit as-builts of all contract documents red-lined reflecting actual installation. The Contractor shall assemble all subcontractor as-builts and submit one complete set of documents with no duplication of Project Document pages. The Contractor shall submit one as-built page for each page of the Contract Documents including plans and specifications. The documents shall be updated with all RFI's, ASI's and modifications to the drawings. Each change shall be clouded and the corresponding RFI or ASI number provided. The electronic copies shall have a separate file for each page labeled as defined in this section.
 - 1. Provide As-built Log referenced herein.
 - 2. Provide list of each RFI and the corresponding page and specification section that was modified.
 - 3. Provide list of each ASI and the corresponding page and specification section that was modified.
 - 4. Submit plan sheets on full size sheets at original drawing scale. All sheets must be the same size.
 - 5. Mark the Contract Documents or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 - 6. Note Construction Change Directive, RFI, ASI numbers, alternate numbers, Change Order numbers and similar identification, where applicable.
 - 7. Identify and date each Record Drawing, including the designation "PROJECT AS-BUILT" in the same prominent location on each sheet.
 - 8. Types of items requiring red-lined marks include, but are not limited to, the following:
 - a. Dimensional changes to the Drawings.
 - b. Revisions to details shown on the Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made following Professional's written orders.
 - k. Details not on the original Contract Drawings.
 - l. Field records for variable and concealed conditions.
 - m. Record information on the Work that is shown only schematically.
 - n. Changes made by Change Order and/or Construction Change Directive.

B. AS-BUILT Site Drawings: The Contractor shall provide GPS coordinates on the final As-Built documents, and shall provide CADD files to the Owner as follows:

1. Locate ALL abandoned underground valve, terminus points/junctions, junction boxes, changes in direction, manholes, fittings, tie-ins, switches, terminus points/junctions, etc. for all utilities known to be abandoned.
2. Locate ALL uncovered, existing underground valve, terminus points/junctions, junction boxes, changes in direction, manholes, fittings, tie-ins, switches, terminus points/junctions, etc. for all utilities known to be abandoned.
3. Locate ALL new underground valves, terminus points/junctions, junction boxes, changes in direction, manholes, fittings, tie-ins, switches, terminus points/junctions, etc. for all new utilities.
4. Projected Coordinate System: State Plane Coordinate System, Mississippi East FIPS 2301, Linear units in Feet, North American Datum 1983.

Projection Details.

Projection: Transverse Mercator.

False_Easting: 984250.00000000.

False_Northing: 0.00000000.

Central_Meridian: -88.83333333.

Scale Factor: 0.99995000.

Latitude of Origin: 29.50000000.

Linear Unit: Foot_US.

5. Geographic Coordinate System: GCS_North_American_1983.
Datum: D_North_American_1983.
Prime Meridian: Greenwich.
Angular Unit: Degree.
Accuracy: Certified within 6".

2.4 PROJECT RECORD DOCUMENTS

- A. Furnish all Project Record Documents as defined here-in.
- B. Submittals: Provide a copy of all approved submittals and shop drawings for the project. Submittals shall be organized by specification section. Shop drawings shall be labeled with the specification section, project name, Professional's project number and description of shop drawing. Provide a table of contents for the submittals and shop drawings. The electronic file copies shall have a separate file for each specification section.
- C. Operations and Maintenance Manuals: Provide Operations and Maintenance Manuals as required in Contract Documents.
- D. Owner Training Videos: Provide video copies of the owner training videos performed. Provide a separate file for each training session and for each type of system or equipment. Do not submit combined video files. The intent is for the Owner to easily reference the files to find the training video for each system and equipment separately. Clearly identify each file with system and equipment type using format defined in this specification section.
 1. Attendance Record: For each training module, submit a list of participants and length of instruction time.

- E. Attic Stock Inventory: Provide an inventory of attic stock and all transmittals signed by Owner. Organize inventory list by specification section. Clearly identify each material, type, color, etc.
- F. Certificates: Provide a copy of all equipment start-up certificates, system certificates, inspection reports, factory start-up reports.
- G. Test & Balance Reports: Provide a copy of the final test and balance report with letter from Contractor certifying that all items have been completed and verified.
- H. Change Orders: Provide a copy of all change orders for the project.
- I. Change Directives Provide a copy of all Change Directives for the project.
- J. Substantial Completion Documents: Provide a copy of the Substantial Completion Certificate and the referenced punch list(s).
- K. Additional Documents Specified Within the Project Manual: Provide all additional certificates, warranties, guarantees, bonds or documents as called for in the individual sections of the Project Manual. The Contractor is responsible for examining the Project Manual for these requirements.

PART 3 - EXECUTION

3.1 ORGANIZATION OF DOCUMENTS

- A. Prior to submission of final pay application, submit 2 hard copies and two electronic copy of each close out document.
- B. Close-out Document Table of Contents and Organization: Organize close-out documents and provide one complete Table of Contents that contains the following format. Organize hard bound sets into manageable three ring binders with clearly defined cover pages and table of contents for each. Organize hard and electronic files in the following format.
 - 1. Cover Page: list project title, Professional, Contractor, Professional's project number, substantial completion date.
 - 2. Substantial Completion Certification and Punch List.
 - 3. Application for Final Payment.
 - a. Consent of Surety.
 - b. Power of Attorney.
 - c. Release of Liens.
 - d. Contractor's Affidavit of Payment of Debts and Claims.
 - 4. Guaranty of Work.
 - a. Contractor's Guaranty.
 - b. Subcontractor's Guaranties.
 - c. Manufacturer's Guaranties.
 - d. Warranty Reference List.
 - 5. As-built Documents.
 - a. Table of Contents of all documents.
 - b. RFI and ASI as-built update log.

- c. RFI and ASI plan change log.
 - 6. Submittals.
 - a. Table of Contents of submittals by specification section.
 - 7. Owner's and Operating Manuals.
 - a. Table of Contents of all manuals by Specification Section.
 - 8. Owner Training Videos.
 - a. Table of Contents of all owner training by Specification Section.
 - 9. Attic Stock Inventory.
 - a. Table of Contents of all attic stock transmitted to owner.
 - 10. Certifications.
 - a. Table of Contents of all certifications.
 - 11. Test and Balance Report.
 - 12. Copy of Contract with Owner.
 - 13. Change Orders.
 - 14. Change Directives.
- C. Provide a separate labeled tab / file for each of the following:
 - 1. Warranty.
 - 2. Certificate.
 - 3. Test Report.
 - 4. RFI.
 - 5. ASI.
 - 6. Change Order.
 - 7. Change Directive.
 - 8. Submittal.
 - 9. Owners & Operating Manual.
 - a. Specification Section.
 - 1) Equipment.
 - 10. As-built Drawing Section.
- D. All the documents are to be submitted in 3 ring binders, with the ability to lock the rings closed, of the appropriate sizes and quantities. No binder will be over 4" thick. All binders will be the same color. Contact the Professional for the color of binders for each project.
- E. Use binders with clear plastic covers over the front/back covers and the edge spline. Insert typed/printed labels on each cover and spline with the following:
 - 1. Project name and numbers.
 - 2. Nature of work (trade package definition).
 - 3. Nature of documents (paragraph 2, above) and book number in the set.

4. Name and telephone number of Contractor.
 5. Name and telephone number of Professional.
- F. Save the electronic copies of all of the above items with each section of work in a separate file that is labeled according to the spec section associated with document.
- G. The first inclusion in every book regardless of the balance of the documents is to be a complete project call list. Include Contractor and every subcontractor and vendor including mailing address, physical address, for the principal office and any branch office who worked on the project, phone and fax numbers for each office listed, primary and secondary contacts, e-mail, addresses, cell phone numbers, pager numbers and home telephone numbers for each contact.
- H. Electronic Filing Format: Label each electronic file in the following manner. Review with Professionals prior to compiling the files to ensure that the desired format is being utilized.
1. General Files:
 - a. Project # _ Specification Section _ File Description
 2. Warranty Files:
 - a. Project # _ Specification Section _ File Description
 3. As-Built Files: Assign a SHT number for each As-built sheet starting with the cover page of the Contract Documents and ending with the last page on the Table of Contents of the Project Plans. The order of the electronic files should be in the same order as shown on the Table of Contents of the Project Plans.
 - a. Project # _ SHT Assigned Number _ Sheet ID per Table of Contents
 4. RFI Files:
 - a. Project # _ RFI # _ RFI Description
 5. Submittal Files:
 - a. Project # _ Specification Section _ Submittal ID _ Submittal Name

3.2 CONTRACT CLOSEOUT DOCUMENT

END OF SECTION 017200

DIVISION 02

EXISTING CONDITIONS

SECTION 024119 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.
4. Saw cutting/core drilling.
5. Patching and repairs.

- B. Related Sections:

1. Division 00 – General Requirements.

1.3 DEFINITIONS

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

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at location coordinated with Architect.
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.

1.6 QUALITY ASSURANCE AND PROTECTION

- A. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Coordinate all hazardous material demolition with the Department of Environmental Quality (DEQ) with their mandatory prior notice requirement (minimum 10 days).
- C. The Contractor shall provide for a safe and secure healthy working environment at all times per OSHA, local code and safe practice.
- D. Temporary barrier, railing fencing, etc. shall be provided and a safely installed to limit access to unauthorized personnel to work areas, limit the spread of construction duct/debris to User occupied spaces, and security for construction trailers, equipment and supplies.
- E. Any Owner furniture, especially cloth materials, shall be substantially protected. Contractor shall cover all furniture and protect blinds, curtains, etc. in demolition and other areas where demolition occurs or where construction routes and/or dust may be interactive.

1.7 SUBMITTALS

- A. See Section 230010 Mechanical General Provisions.
- B. Submit product data, O&M data, and samples and show item on shop and coordination drawings according to the following table.
1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Proposed protective measures report				R
Schedule of selective demolition activities				R
Pre-work / pre-demolition photos				R
Statement of refrigerant recovery per EPA regulations				R
Warranties (documentation indicating existing warranties are in effect after completion of selective demolition)				R

1.8 PROJECT 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. Owner will occupy all buildings and grounds immediately adjacent to this building and some selective demolition areas. Conduct selective demolition so that Owner's operations will not be disrupted. Provide not less than 72 hours' prior notice to Owner of activities that will affect Owner's operations, including traffic dust, noise, etc.
- C. Owner assumes no responsibility for actual condition of buildings or systems to be selectively demolished.
- D. Asbestos and Lead Based Paint: If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify the Professional and the Owner.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Removal, relocation of some of the furniture in construction areas shall be by the Owner. The remainder of furniture, fixtures and built-ins shall be protected by the Contractor during all construction. All areas, furniture and fixtures left in the construction area shall be daily cleaned and thereafter comprehensively cleaned after construction is complete in each space or room, at the Contractor's expense.
- G. 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.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 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.

2.2 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible as approved by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped, as appropriate, to safety protect occupants and the facilities.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required. Minimally demolish to match the extent to adequately access for repair or replacement work necessary.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Professional and provide suggested remedial action and cost estimate(s).
- D. Survey the condition of the building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition. Contact the Professional immediately if an unsafe condition is noted. Protect people first and foremost.
- E. Survey Existing Conditions: Record existing pre-demolition conditions by use of photographs and/or video. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 SCOPE

- A. Remove portions of walls and devices systems including, but not limited to ceiling tiles, ceiling grid, gypsum board ceilings, devices, piping, cabling, conduit, ductwork, exterior wall systems (including brick, concrete block, flashing, masonry ties, etc.), lights, and existing HVAC equipment indicated to be removed, and all part/accessories as noted in the Construction Specifications and Drawings in order to provide, install, and seal all fire and smoke rated partitions.
- B. Remove other items indicated, for salvage and relocation.
- C. Removal of all hazardous materials found/uncovered during demolition and renovations shall be removed and disposed of as per all local, state, and federal requirements. The contractor shall provide all dump tickets, chain of custody documents, clearances/testing, and all disposal documents to the professional within 72 hours of disposal.

- D. All demolition procedures shall be done in a manner that will protect the existing walls, flooring, base, ceilings, doors, devices; mechanical, electrical, and life-safety systems; and all devices and elements on the interior surfaces of the building. All building surfaces shall be protected from adhesives, fire-caulking, scratches, stains, dents, and any damage during renovations. (Any damage to the building surface or systems shall be repaired at the Contractor's expense and to meet all requirements as specified here-in, to match existing adjacent surfaces/finishes, and as indicated in the drawings.)

3.3 GENERAL PROCEDURES AND PROJECT CONDIITONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Provide all shoring, bracing, supports, and take precautions to prevent catastrophic or uncontrolled collapse and cracking of structures and wall systems to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways, corridors, or sidewalks without permit or permissions.
 - 9. Conduct operations to prevent obstruction of public and private entrances, corridors, and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner
- C. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.
- F. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Dismantle existing construction and separate materials.
 - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.4 PREPARATION

- A. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of unauthorized non construction personnel around selective demolition area(s).
 - 1. Erect temporary protection, such as walks, fences railings, canopies, temporary construction barriers, and covered passageways, where required by authorities having jurisdiction.
 - 2. Provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces and new construction to ensure that no water leakage or damage occurs to structure or interior areas.

3.5 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
 - a. Provide not less than seven (7) days written prior notice to Owner if shutdown of service is required during any changeover, replacement, repair, etc.
 - b. Utility Requirements: Refer to requirements outlined herein and in Divisions 21, 22, 23 and 26 for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.
- 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 Owner and/or utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping at the main from which it is served with same or compatible piping material.
 - b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - c. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - d. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - e. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts at the main from which it is served with same or compatible ductwork material.

3.6 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. Provide temporary enclosures, dust control, heating, and cooling as required.
- 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.

3.7 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 fire watch during and for at least four hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 10. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.

11. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Reinstalled Items:
 1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.8 SELECTIVE DEMOLITION – SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts. Do not use power-driven impact tools during Owner's normal occupied periods.
- 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. Remove resilient floor coverings and adhesive according to recommendations of the Resilient Floor Covering Institute's (RFCI) "Recommended Work Practices for the Removal of Resilient Floor Coverings" and Addendum.
 1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- E. Remove no more existing walls or roofing than can be promptly covered and interior areas protected.
- F. Remove HVAC equipment without releasing refrigerants. Recover all refrigerants and oils per governing codes.
- G. Provide temporary walls and seal air tight between construction areas and Owner occupied spaces. Construction barriers shall be provided where shown and as required, per Architect's directive.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials to an appropriate disposal site per local code requirements. Do not allow demolished materials to accumulate on-site or in building renovation areas.
- B. Promptly haul off debris and demolition and unused construction material and equipment.

3.10 PATCHING AND REPAIRS

- A. Restore walls, roofs, floors, ceilings, etc. to like new condition matching the surrounding finishes prior to demolition.
- B. See additional requirements in Division 01.

3.11 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.
- B. Clean and sweep the building, equipment room and outdoor concrete spaces, broom clean and provide for a thorough comprehensive vacuuming and dust removal on completion of selective demolition operation, at minimum daily intervals and prior to next day Owner occupancy of premises.
- C. All areas affected by construction dust shall be thoroughly cleaned. All furniture, plumbing and light fixtures, wall, ceiling, and floor surfaces shall be cleaned.

END OF SECTION 024119

DIVISION 23

HVAC

MECHANICAL TABLE OF CONTENTS

DIVISION 23

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END OF SECTION MECHANICAL TABLE OF CONTENTS



SECTION 230010 – MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DIVISION OF WORK

- A. This section delineates the division of work between Divisions.
- B. Consult all other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation. This section is provided to assist the Contractor in coordination of work scope but shall not be construed to limit Contractor’s scope of work encompassed by the contract documents.
- C. Coordination with other Trades: The following table is intended to assist the Contractors in coordinating the scope of work between Division 23 (Indicated as 23 in table), Section 230900 Energy Management & Control System (indicated as 23C), and other Divisions as indicated. However, the General Contractor is ultimately responsible for coordination among his subcontractors regardless of what is listed in this Section.

INTERFACE/RESPONSIBILITY MATRIX						
System	Division under which the following is specified				Remarks	
	Equipment	Installation	Power Wiring [1]	Control & Interlock Wiring [1]		
FIRE & LIFE SAFETY SYSTEMS						
Duct mounted & in-direct mounted smoke detectors	26	23	26	26/ 23C	[2]	
MECHANICAL EQUIPMENT						
Packaged mechanical equipment	23	23	26	23C	[3]	
HVAC SHEET METAL						
Duct mounted sensors	23C	23	23C	23C		
Filter gauges	23C	23C	-	-		
PIPING						
Natural gas piping and pressure regulators	23	23	-	-	[4]	
Condensate piping	23	23	-	-	[5]	
MISCELLANEOUS						
Cutting, patching, repairs, restoration, painting, etc.	23	23	-	-	[6]	
Concrete housekeeping pads for equipment	23	23	-	-		
Equipment, ductwork, and piping steel supports and	23	23	-	-		

INTERFACE/RESPONSIBILITY MATRIX						
System	Division under which the following is specified				Remarks	
	Equipment	Installation	Power Wiring [1]	Control & Interlock Wiring [1]		
frames						
Painting of exposed piping, HVAC equipment, etc.	23	23	-	-		
Repairs to ceilings, ceiling grids, and ceiling tiles	23	23	-	-	[7]	
NUMBERED REMARKS: [1] Wiring includes raceway, fittings, wire, boxes and related items, all voltages [2] Wiring of interlock of duct smoke detectors to shut off supply fans upon detection of smoke is specified under Section 230900 Energy Management & Control System. All other smoke control/fire alarm related control wiring is specified under Division 26 Electrical. [3] Pressure reducing valves to deliver gas at the pressure required by mechanical equipment, including final connections and shut-off cock, is specified under Division 22 Plumbing. All other gas control and regulating devices provided under the Section providing the gas-fired equipment. Venting of gas regulating devices and other equipment gas-train devices where required is specified under Division 22 Plumbing. [4] Contractor shall provide natural gas piping to new DOAS unit in accordance with the 2018 International Fuel Gas Code. Provide pressure regulator as required by mechanical equipment, including final connections and shut-off cock. Coordinate increased natural gas load with serving natural gas utility provider. All cost associated with upgrades to the natural gas service shall be included in the Contractor's bid. [5] Contractor shall install condensate piping from new DOAS to nearest below grade storm or sanitary sewer. Connect to existing below grade sewer piping and extend up thru new DOAS concrete pad and terminate with a hub drain. Route condensate piping from DOAS to hub drain and terminate down into hub drain. [6] Contractor shall be responsible of all cutting, patching, repairs, restoration, painting, etc. of finishes damaged or modified as part of work performed under this contract. Contractor shall be responsible for restoring all finishes to the condition and appearance prior to beginning work under this contract. [7] Contractor shall repair all ceilings, ceiling grid, and ceiling tiles damaged as part of work performed under this project. Ceiling repairs, new ceiling grid, and new ceiling tiles shall match existing.						

D. HVAC/Electrical Design Coordination

1. The power ratings of motors and other HVAC equipment and the electrical characteristics of electrical systems serving them, as specified herein and indicated on the Drawings, have been established as minimums which will allow that equipment to satisfactorily function while producing the required capacities. These power ratings include a safety factor deemed appropriate to accommodate common differences between design parameters and field construction practices. Under no circumstances shall equipment with power ratings less than those indicated on the Drawings or specified herein be provided.
2. Reasonable efforts have been made to coordinate the electrical requirements of the HVAC equipment with the electrical systems serving that equipment. Differences among manufacturers of HVAC equipment make it impossible to produce a single electrical design which will satisfy the varying electrical requirements of those manufacturers. Consequently, the Contractor shall coordinate the electrical requirements of the HVAC equipment actually furnished on this Project and provide the electrical systems required by that equipment. This coordination effort shall be completed prior to the installation of either the HVAC equipment or the electrical systems serving

that equipment. Electrical system revisions required to coordinate with the HVAC equipment actually furnished shall be provided at no additional cost to the Owner.

E. Related Work Specified Elsewhere

1. Painting (except as specifically indicated): See Division 09 Finishes
2. Electric power, interlock, and control wiring, except as specified herein.
3. Concrete equipment pads.

1.3 REFERENCE STANDARDS

A. Reference to codes, standards, specifications and recommendation of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.

B. Work shall be performed in accordance with all applicable requirements of the latest edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not.

C. Requirements of Regulatory Agencies

1. In accordance with the requirement of Division 1 General Requirements.
2. Nothing in contract documents shall be construed to permit work not conforming to current and applicable laws, ordinances, rules and regulations.
3. Where contract documents exceed requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.
4. It is not the intent of contract documents to repeat requirements of codes except where necessary for completeness or clarity.
5. Comply with the Safety Orders issued by OSHA and any other safety, State health or environmental regulations and any districts having jurisdictional authority. Where an omission or conflict appears between OSHA requirements and the Drawings and Specifications, OSHA requirements shall take precedence.
6. Applicable codes as listed below, in addition to others specified in individual sections.
 - a. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) – Standard 90.1-2010 “Energy Standard for Buildings Except Low-Rise Residential Buildings”.
 - b. International Building Code (IBC) – 2015.
 - c. International Mechanical Code (IMC) – 2015.
 - d. International Plumbing Code (IPC) - 2015.
 - e. NFPA 1 – 2015, Fire Code
 - f. NFPA 70 - 2014, National Electric Code
 - g. NFPA 90A - 2015, Installation of Air Conditioning and Ventilating Systems

D. Published specifications, standards, tests or recommended method of trade, industry or governmental organizations as listed below apply to all work in Division 23 HVAC, in addition to other standards which may be specified in individual sections.

E. All base material shall meet ASTM and ANSI standards.

F. All Gas Fired Devices: Comply with standards and bear label of AGA.

G. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped.

H. All Electrical Devices and Wiring

1. Conform to standards of NEC
 2. All devices UL or ETL listed and identified
- I. Guidelines and Standards: The latest edition of guidelines and standards published by the following govern the Mechanical Systems and associated support system design. The systems shall be designed to meet or exceed these guidelines and standards.

AABC	Associated Air Balance Council
ADC	Air Diffuser Balance Council
AGA	American Gas Association
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASC	Adhesive and Sealant Council
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
ETL	Interlek Semko (Formerly Electrical Testing Laboratories)
GISO	General Industry Safety Orders
HI	Hydraulic Institute
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriter's Laboratories, Inc.

1.4 QUALITY ASSURANCE

- A. Supply all equipment and accessories in compliance with the applicable standards listed herein and with all applicable national, state and local codes.
- B. All equipment and accessories shall be new, and the product of a manufacturer regularly engaged in its manufacture.
- C. All items of a given type shall be the products of same manufacturer.
- D. Workmanship, material and equipment shall be in accordance with Specifications and Drawings and in some instances the requirements exceed those required by codes and standards. Where not exceeded, the codes and standards shall be considered as absolute minimum requirements.

1.5 SUBMITTALS

- A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformance with the design intent and the Contractor has responded to all comments to the satisfaction of the Owner.

- B. Submit drawings, product data, samples and certificates of compliance required as hereinafter specified. See also Division 01 – General Requirements.
- C. Submit no later than 35-days after signing of Contract, or as otherwise indicated by Architect. Submit a schedule indicating the proposed submission date of each submittal specified herein. Schedule shall anticipate the submittal review time, the possible need for resubmittals, and the time required for fabrication, shipping and integration into the construction sequence. Architect will advise of any conflicts in reviewing submittals that the proposed schedule presents.
 - 1. Complete schedule of submittals for equipment and layout shop drawings. Allow 15-working days for review unless Architect agrees to accelerated schedule.
 - 2. List of all proposed substitutions: See requirements herein.
 - 3. Designate in schedule dates for submission and dates that reviewed shop drawings, product data and samples will be needed.
 - 4. Provide submittals promptly in accordance with schedule and in such sequence as to cause no delay in work or in work of any other division.
- D. Submit drawings, product data, samples and certificates of compliance required hereinafter specified.
 - 1. See also Division 01 General Requirements.
 - 2. Provide submittals promptly in accordance with schedule and in such sequence as to cause no delay in work or in work of any other division.
 - 3. Submittals for each specification section shall be submitted in a single package. However, it is not required (nor desired) for all products to be submitted concurrently. Rather, submittals may be staggered based on schedule and required equipment release dates.
 - 4. Allow 15-working days for review unless the Architect agrees to accelerated schedule.
 - 5. For substitutions, list any features or characteristics that are not strictly in compliance with specifications. If none are listed with the submittal, Contractor is guaranteeing that substituted product is functionally equivalent to the specified product in accordance with requirements herein.
 - 6. Submittal reviews by the Architect are intended to assist the Contractor in complying with the design intent and requirements of the drawings and specifications. Reviews do not relieve the Contractor from compliance with these requirements and comments or lack thereof does not constitute approval of changes in these requirements.
- E. Submission and Resubmission Procedure.
 - 1. Each submittal cover sheet shall contain the Contractor’s review statement. The statement shall be worded as follows:
 - a. It is hereby certified that the information included in this submittal and approved/proposed to be incorporated into this project (include official project name on Contract Drawings), is in compliance with the Contract Drawings and specifications, the electrical requirements have been coordinated with the Electrical Sub-Contractor, can be installed in the allocated spaces with adequate service space, and is approved for use and is submitted for Architect’s review.

Authorized Reviewer: _____ Date: _____

- 2. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as “SUBMITTAL 23 xx xx-01”.
- 3. Each resubmittal shall have the original unique serial number plus revision number such as “SUBMITTAL 23 xx xx-01 REVISION 1”.
- 4. Submit in format specified below. Submissions made in wrong format will be returned without action.

- a. Product Submittals: One copy in word-searchable electronic format per requirements herein. Submit each specification section in a separate file named with unique name and number described above.
 - b. Shop Drawings:
 - 1) One copy in electronic format .dwg, .dwf, or .pdf
 - 2) Two and only two copies on paper; any additional copies will not be returned without review
 - c. Samples: As indicated in each specification section.
5. Architect will return a memo or mark-up of submittal with comments and corrections noted where required.
 6. Make corrections
 - a. Revise initial submittal to resolve review comments and corrections.
 - b. Indicate any changes that have been made other than those requested.
 - c. Clearly identify resubmittal by original submittal number and revision number.
 7. Resubmit revised submittals until “No Exceptions” or “Furnish as Corrected” is provided by the Professional.
 8. Once submittals are accepted and stamped with “No Exceptions” or “Furnish as Corrected”, provide:
 - a. Complete submittal of all accepted products in a single electronic file for each specification section.
 - b. Photocopies for coordination with other trades, if and as required by the Contractor or Architect. Photocopies will serve as submittal for record and coordination.
 9. The stipulation included with the Professionals remarks with “Furnish as Corrected” indicate provisional acceptance.

F. Product Data Submittals

1. Contents.
 - a. Manufacturer’s name and model number.
 - b. All information required to completely describe materials and equipment and to indicate compliance with drawings and specifications, including, but not limited to:
 - 1) Schedule when more than one of each item is covered by submittal.
 - 2) Physical data, as applicable.
 - a) Dimensions.
 - b) Weights.
 - c) Finishes and colors.
 - d) Dimensional shop drawings.
 - 3) Performance data, as applicable.
 - a) Rated capacities.
 - b) Performance curve.
 - c) Operating temperature and pressure.
 - d) Efficiency.
 - 4) Flow and wiring diagrams as applicable.
 - 5) Description of system operation.

- c. All other pertinent information requested in individual sections.
2. Format.
- a. See Division 01 – General Requirements.
 - b. Identify clearly if submittal is substitution: See requirements herein.
 - c. Reference specification Division, Section, Title, Paragraph and Page number or drawing number as applicable
 - d. Use same nomenclature, legend, symbols, and abbreviations on submittal material as used in contract documents.

G. Samples.

- 1. Submit as required in each specification section.

1.6 COORDINATION DRAWINGS (LAYOUT SHOP DRAWINGS)

A. Coordination drawings.

- 1. Drawings shall be developed in format compatible with AutoCAD version 2010 or later.
- 2. Shop fabrication, coordination and installation drawings by the Contractor, are for the Contractor's use and shall be the Contractor's responsibility. These Drawings indicate where the Contractor intends to install the material and equipment as required by the Contract Documents. Submit coordination drawings in a timely manner so that they can be utilized by all trades. Use of contract documents or electronic files of contract documents for shop drawings is not sufficient.
- 3. Clearly indicate deviations from Contract Drawings.
- 4. Review is not intended to verify dimensions or quantities, or to coordinate items shown on these Drawings. Review is for general conformance with design concept of the Project and general compliance with the information given in the Contract Documents. Contractor is responsible for dimensions, which shall be confirmed and correlated at the Jobsite, for fabrication processes and techniques or construction, for coordination of Work with that of all other trades and the satisfactory performance of Work.
- 5. Prepare and submit layout drawings, sections and details for following areas, minimum 1/4-inch scale:
 - a. Congested areas (ceiling plenums, furring's, shafts, etc.)
- 6. Prepare layout shop drawings for all other areas; minimum 1/8-inch scale.
- 7. Layout drawings, as a requirement of Division 23 HVAC, shall indicate, superimposed, Work of all Sections involved in congested area, including ductwork, piping, electrical work, ceiling work, etc. Include all mechanical rooms. Identification of space problems without solutions is not acceptable.
- 8. Individual coordinated trade layout drawings are to be prepared for all deviations from design documents.
- 9. Contractor is to assure that each trade has coordinated work with other trades, prior to submittal.
 - a. Include stamp on each submittal indicating that layout shop drawing has been coordinated:
 - b. No layout shop drawing will be reviewed without stamped and signed coordinated assurance by Contractor.
- 10. All changes shall be clearly marked on each submitted layout drawing.
- 11. Drawings shall show work of all trades including but not limited to:
 - a. Ductwork.
 - b. Piping: All Trades, including Fire Sprinklers and electrical installations.

- c. Mechanical Equipment.
 - d. Electrical Equipment.
 - e. Main Electrical conduits and bus ducts.
 - f. Equipment supports and suspension devices.
 - g. Structural and architectural constraints (structural steel, columns, ceilings, walls, floors, etc.).
 - h. Show location of:
 - 1) Valves: manual and automatic.
 - 2) Air distribution devices (including sidewall devices with dimensions from finish floor elevation).
 - 3) Exterior wall penetrations (include dimensions from reference elevation).
 - 4) Piping specialties.
 - 5) Dampers: fire/smoke, automatic and manual volume, etc.
 - 6) Access doors.
 - 7) Control and electrical panels.
 - 8) Others as required for clear coordination.
12. Equipment, control devices, dampers, valves, etc. requiring periodic maintenance or adjustment shall be included in coordination drawings. Specifically, the contractor shall verify and coordinate that access is provided to these components via lay-in ceiling or adequately sized access doors in walls, floors, ceilings, etc.
13. Submission of drawings.
- a. Submit to other trades for review of space allocated to all trades.
 - b. Revise drawings to compensate for requirements of existing conditions and conditions created by other trades.
 - c. Ensure that each trade has coordinated work with other trades.
 - d. Submit with stamps of General and all other applicable Contractors, initialed and signed certifying.
 - 1) Review of submittal.
 - 2) Verification of products, field measurements and field construction criteria.
 - 3) Coordination of information in submittal with requirements of work of this Division and other divisions of Contract Documents.
 - e. No layout shop drawing will be reviewed without stamped and signed coordination assurance by the Contractor.

1.7 COMPLETION REQUIREMENTS

A. Procedure.

- 1. Until the documents required in this section are submitted and approved, the system will not be considered "accepted".
- 2. Before requesting acceptance of work, submit one set of Completion Documents for review and approval of Architect.
- 3. After review, furnish quantity of sets indicated below to Owner.
- 4. Format:
 - a. See herein for required format of Completion Documents.
 - b. Paper Copies: Assemble in chronological order following alpha-numeric system used in specification, in heavy three-ring binder.
 - c. Where electronic copies are called for herein, comply with the following:

- 1) Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf) and HTML; submit other formats for review and approval prior to submission; scanned paper documents not acceptable.
- 2) For submittals, provide separate file for each type of equipment.
- 3) For Test & Balance report, provide separate files for each air handling system.
- 4) Record drawings shall be in original format.

B. Operating and Maintenance (O&M) Manual.

1. See O&M Manual requirement herein

C. Record Drawings.

1. Keep up-to-date during progress of job one set of Mechanical Drawings indicating the Record installation. In addition to changes made during course of Work, show following by dimension from readily obtained base lines.
 - a. Fully illustrate all revisions made by all crafts in course of work.
 - b. Include all field changes, adjustments, variances, substitutions, and deletions, including all Change Orders.
 - c. Exact location, type and function of concealed valves, dampers, controllers, piping, air vents and piping drains.
 - d. Exact size, invert elevations and location of underground and under floor piping and ducts.
 - 1) Progress drawing set shall be available for inspection by Architect weekly.
 - 2) Update engineering design drawings and shop drawings to reflect revisions and additional data listed above at completion of Project.
 - e. Original engineering design drawings will be provided to Contactor in electronic format compatible with AutoCAD version 2010 or later.
 - f. Both shop and engineering design drawings shall be in format compatible with AutoCAD version 2010 or later.
 - g. Drawings required to be updated if revisions were made.
 - 1) Floor plans.
 - 2) Shop drawings required herein.
 - 3) Sections.
 - 4) Riser diagrams.

D. Test and Balance Reports.

1. See Section 230593 – Testing, Adjusting, and Balancing for HVAC.

E. Training Materials.

1. See Training Materials requirements herein.

F. Miscellaneous Certificates.

1. Training/Instruction completion certificates.
2. Final inspection certificate signed by governing authorities.
3. Warranty period, including start and end period.
4. Field test report, including as applicable.
5. Start-up documents with date and name of technician.
6. Piping pressure tests.
7. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.
8. Others as specified herein and in other Division 23 – Mechanical sections.

G. Format of Completion Documents.

1. Provide the type and quantity of media listed in table below.
2. Optical media shall be readable on a personal computer.
3. Where indicated in table, the electronic files shall be stored on the EMCS systems' Operator Workstation and hyperlinked to the front-end DDC controls graphics so operators can get the details of a certain device or balance reports by clicking on the link: See Section 230900 – Energy Management & Control Systems.

Document	Paper (Binder or bound)	Electronic	
		USB Flash Drive	Loaded Onto Operator Workstation
O&M Manuals	3	1	1
Record Drawings	2 Full sizes	1	1
	2 Half sizes		
Original issue EMCS software & manuals	1	1	1
Control sequences	1	1	1
Test and Balance Report	5	1	1
Miscellaneous Certificates	1	1	1
Warranty documents	1	1	1
Training materials	1 per trainee	1	1

1.8 SUBSTITUTIONS AND PRODUCT OPTIONS

- A. For specific substitution requirements, See Division 00, and Division 01.
- B. Where equipment and materials are shown on the drawings and/or specified hereinafter by a manufacturer's name and/or model number, it is the intent of these specifications to set minimum definite standards for equipment and materials to be used on the project. It is not the intent of these specifications to preclude the use of materials and equipment of similar design and quality to manufacturer's name specified. If the Contractor desires to substitute materials and equipment, he shall obtain written approval through the materials submittals process of all such substitutions before such substitutions are made. Unauthorized substitutions of materials and equipment may be ordered removed from the project without further grounds. The Architect will not approve any substitutions for specified materials and equipment unless such substitutions are requested by the Contractor.
- C. The products of particular manufacturers have been used as the basis of design in preparation of these documents. It shall be the responsibility of this Contractor to determine if the submitted materials and equipment will fit into the space allotted with all required clearances as the materials and equipment utilized as the basis of design. Furthermore, the Contractor shall verify and maintain adequate access to equipment, valves, filters, lubrication outlets, etc. Any changes to the building or system design necessary shall be arranged for in writing before the materials and equipment is ordered. All costs involved in making such changes shall be borne by the Contractor. If such changes are deemed inadvisable by the Architect, the Contractor shall install items specified even though materials and equipment had been previously approved. Architect's approval of materials and equipment other than the basis of design is for performance only.
- D. Contractor shall consider the following parameters (at a minimum) when considering materials and equipment substitutions:
 1. Capacities: The capacities included in the Contract Documents are absolute minimum and the substitution shall have equal or greater capacities.

2. Physical size limitations: Substitutes shall fit in the allotted space and shall have the manufacturer's minimum clearances.
3. Installation and operating weights.
4. Structural properties.
5. Noise levels.
6. Vibration.
7. Interchangeability.
8. Accessibility for maintenance, operation, and replacement.
9. Compatibility with other materials and assemblies.
10. Equal quality and style.

1.9 DESCRIPTION OF BID DOCUMENTS

- A. The Contractor shall be responsible for becoming thoroughly acquainted with all Contract Document contents that affect his work under this contract. Work required under this section includes, but is not limited to, all material, equipment transportation, services and labor required to complete the entire mechanical system as required by the Contract Documents.
- B. The Specifications and the associated Drawings are complimentary, and any portion of the work described in one shall be provided as if described in both.
- C. Specifications.
 1. Specifications, in general, describe quality and character of materials and equipment.
 2. Specifications are of simplified form and include incomplete sentences.
 3. Words or phrases such as "The Contractor shall," "shall be," "furnish," "provide," "a," "an," "the," and "all" have often been omitted from specifications for brevity.
- D. Drawings.
 1. Drawings are diagrammatic in nature and, unless explicitly dimensioned, indicate approximate locations of apparatus, equipment, ductwork, and piping. Changes in the location, and offsets, of same which are not shown on the Drawings but are necessary in order to accommodate building conditions and coordination with the work of other trades, shall be made during the preparation of coordination drawings and prior to initial installation, without additional cost to the Owner. Contractor shall install all system components in such a manner as to conform to the structure, avoid obstructions, preserve headroom, keep openings and passageways clear and maintain required servicing clearances without further instructions or additional cost to the Owner.
 2. Scaled and figured dimensions are approximate and are for estimating purposes only. Indicated dimensions are limiting dimensions where noted. Duct and piping elevations are indicated for initial coordination; final requirements shall be determined by the Contractor after final coordination with other trades.
 3. Before proceeding with work, check and verify all dimensions in field.
 4. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
 5. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.
 6. It is intended that all mechanical, plumbing and fire protection devices, piping, etc. be located symmetrically with all architectural elements. Refer to Architectural, Structural, Plumbing, Fire Protection, Mechanical and Electrical Specifications and Drawings in completing the required coordination.
 7. The Contractor shall fully inform himself regarding any and all peculiarities and limitations of the spaces available for the installation of all work and materials furnished and installed under this Contract. He shall exercise due and particular caution to determine that all parts of his work are made readily accessible.

8. The Contractor shall study all drawings and specifications to determine any conflict with all applicable ordinances and statutes. Any discrepancies shall be reported to the Owner and any changes shall be shown on the as-built drawings with the additional work performed at no cost to the Owner.
 9. The submittal of his bid shall indicate the Contractor has examined the site, drawings and specifications and has included all required allowances in his bid. No allowance shall be made for any error or omission resulting from the Contractor's failure to visit job site and to review drawings and specifications. The Contractor's bid shall include costs for all required drawings and changes as outlined above at no cost to the Owner.
 10. Provide access to equipment and apparatus requiring operation, service or maintenance throughout the life of the system.
- E. Do not use equipment exceeding dimensions indicated on drawings or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.
 - F. If any part of Specifications or Drawings appears unclear or contradictory, apply to Architect for an interpretation and decision prior to bid and as early as possible.
 1. Do not proceed with work without the decision of the Architect.
- 1.10 ALTERNATES (N/A)
- A. Refer to Division 01 – General Requirements.
- 1.11 DEFINITIONS
- A. In addition to those defined in Division 01 – General Requirements, the following additional definitions shall apply. Definitions of term used in Division 23 HVAC may differ from those given in general and supplementary conditions.
 - B. "Provide": to furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.
 - C. "Supply": to purchase, procure, acquire, and deliver complete with related accessories.
 - D. "Work": includes labor, materials, apparatus, controls, equipment services and all related accessories necessary for the proper and complete installation of complete systems.
 - E. "Piping": includes pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and all related accessories.
 - F. "Wiring": includes raceway, fittings, wire, boxes, and all related accessories.
 - G. "Concealed": not in view, installed in masonry or other construction, within furred spaces, double partitions, hung ceiling, trenches, crawl spaces, or enclosures.
 - H. "Exposed": in view, not installed underground or "concealed" as defined above. Exposed piping, conduit, or ductwork is that which can be seen when the building is complete without opening or removing access doors or panels or accessible ceiling components.
 - I. "Control or Actuated Devices": includes automatic sensing and switching devices such as thermostats, pressure, float, flow, electro-pneumatic switches, and electrodes controlling operation of equipment.
 - J. "Indicated," "shown" or "noted": as indicated, shown, or noted on drawings or specifications.

- K. "Reviewed," "approved," or "directed", as reviewed, approved or directed by or to Owner.
- L. "Motor Controllers": starter, variable speed drives and other devices controlling the operation of motors.

1.12 PROJECT CONDITIONS

- A. Examine site related work and surfaces before starting work of any Section.
 - 1. In case of conflict, the most stringent takes precedence.
 - 2. For purposes of clarity and legibility, Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Especially note a number of required duct and pipe offsets to coordinate with structure and not shown. Coordinate dimensioned conditions, including invert elevations, with other trades prior to installation by any trade.
 - 3. Exact routing of piping, ductwork, etc. shall be governed by structural conditions and other obstructions. Not all offsets in ductwork or piping are shown on the Drawings. Determine which item to offset or relocate. Maintain required slope in piping. Make use of data in Contract Documents. In addition, Architect reserves right, at no additional cost to the Owner, to make any reasonable change in location of mechanical items, exposed at ceiling or on walls, to group them into orderly relationships or increase their utility. Verify Owner's requirements in this regard prior to rough-in.
 - 4. Take dimensions, location of doors, partitions, similar physical features from Architectural Drawings. Verify at Site under this Division. Consult Architectural Drawings for exact location of outlets to center with Architectural features, panels, etc., at the appropriate location shown on Mechanical Drawings.
 - 5. Mounting heights of brackets, outlets, etc., as required.
 - 6. Report to Architect, in writing, conditions which will prevent proper provision of this work.
 - 7. Beginning work of any Section without reporting unsuitable conditions to Architect constitutes acceptance of conditions by Contractor.
 - 8. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to the Owner.
- B. Coordination.
 - 1. Work out all "tight" conditions involving Work specified under this Division and work in other Divisions in advance of installation, if necessary, and before Work proceeds in these areas, prepare supplementary Drawings under this Division for review showing all Work in congested area. Provide supplementary Drawings, additional Work necessary to overcome congested conditions, at no additional cost to the Owner.
 - 2. Conflicts: Difference or disputes concerning coordination, interference, or extent of Work between sections shall be decided as follows:
 - a. Install mechanical and electrical systems in the following order of preference (those trades listed below another must reroute to resolve the conflict):
 - 1) Drain piping required by code to be sloped.
 - 2) Supply air and exhaust air ductwork connected to fans.
 - 3) Electrical conduit 4 inches and larger.
 - 4) Hydronic piping connected to pumps.
 - 5) Domestic water piping.
 - 6) Fire sprinkler piping.
 - 7) Electrical conduit smaller than 4 inches.
 - 8) Transfer ducts and other ductwork not connected to fans.
 - 9) Control system piping and wiring.
 - b. Continued disputes shall be decided by Contractor and Contractor's decision, if consistent with Contract Document requirements, shall be final.

3. Supervision: Personally, or through an authorized and competent representative, constantly supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the Project throughout the Project duration.
4. Provide templates, information, and instructions to other Divisions to properly locate hides and openings to be cut or provided.
5. The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality shall apply. Such discrepancies shall be noted and clarified in the Bid. No additional allowances will be made because of errors, ambiguities, or omissions that reasonably should have been discovered during the preparation of the Bid.

C. Equipment Rough-in.

1. Rough-in locations shown on Mechanical Drawings for equipment furnished by the Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources.
 - a. From Shop Drawings for equipment provided under this contract.
 - b. From Architect for Owner Furnished-Contractor installed equipment.
 - c. From existing equipment where such equipment is relocated under this Contract.
2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Architect and provide as directed by the Architect at no additional cost to the Owner.
3. Make final connections.

1.13 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping, equipment or ductwork.

1. Prohibited, except as noted in:
 - a. Electric rooms and closets over equipment, as restricted by NEC.
 - b. Telephone rooms and closets.
 - c. Elevator machine rooms.
 - d. Elevator shafts.
 - e. Electrical switchboard room.
 - f. Communications room.
2. Prohibited, except as noted, over or within 5 feet of:
 - a. Transformers.
 - b. Substations.
 - c. Switchboards.
 - d. Motor control centers.
 - e. Standby power plant.
 - f. Bus ducts.
 - g. Electrical panels.
 - h. Variable frequency drives.
 - i. Starters.

B. Drip pans under piping.

1. Where piping is located over any electrical equipment listed above; reroute piping, if possible, rather than use drip pan.
2. 28 gage galvanized steel.

3. 18 gage copper.
4. Reinforced and supported.
5. Watertight.
6. With 1-1/4-inch drain outlet piped to floor drain or service sink.

C. Electrical Working Space: Dimensions of the working space shall be a minimum depth of 42" horizontally, the width of the equipment or 30", whichever is greater, and the height of the equipment or 78", whichever is greater. Minimum depth shall be increased to 60" for equipment rated over 600 V.

1.14 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. See Division 01 – General Requirements (Product Requirements).
- B. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Provide protective coverings during construction.
- C. Handle and ship in accordance with manufacturer's recommendations.
- D. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed with no exceptions taken Shop Drawings.
- E. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no additional cost to Owner.
- F. Where necessary, ship in crated sections of size to permit passing through available space.

1.15 PROJECT MANAGEMENT AND COORDINATION SERVICES

- A. See Division 01 – General Requirements.
- B. Overview: Provide a project manager/engineer for the duration of the Project to coordinate the Division 23 HVAC work with all other trades. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.
- C. Review of shop drawings prepared by other subcontractors
 1. Obtain copies of all shop drawings for equipment provided by others that require electrical service connections or interface with Division 23 HVAC work.
 2. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 23 HVAC contract documents. Document and discrepancy or deviation as follows:
 - a. Prepare memo summarizing the discrepancy.
 - b. Provide a copy of the specific shop drawing, indicating via cloud, the discrepancy.
 3. Prepare and maintain a shop drawing review log indicating the following information.
 - a. Shop drawing number and brief description of the system/material.
 - b. Date of review.
 - c. Indication if follow-up coordination is required.
- D. Request for Information (RFI)
 1. See Division 1 Request for Information

1.16 REVIEW OF CONSTRUCTION

- A. Work may be reviewed at any time by representatives of the Owner and/or Architect.
- B. Advise Owner that work is ready for review at the following times.
 - 1. Prior to backfilling buried work.
 - 2. Prior to concealment of work in walls and above ceilings.
 - 3. When all requirements of Contract have been completed.
 - 4. When testing will be performed.
- C. Do not backfill or conceal work without Architect's consent.
- D. Maintain on site, one set of Specifications and Drawings for use by Owner and/or Architect.
 - 1. Include all change orders.
- E. Contractor is responsible for construction methods, sequences, and safety precautions.

1.17 SCHEDULE OF WORK

- A. In accordance with Division 01 – General Requirements and as follows:
 - 1. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.
 - 2. In scheduling, anticipate means of installing equipment through available openings in structure.
- B. Confirm in writing to Architect, within 35-days of signing of contract, anticipated number of days required to perform test, balance, acceptance testing and commissioning of mechanical systems. Schedule test balance and acceptance testing of mechanical systems as follows:
 - 1. Submit for review at this time, names and qualifications of test and balancing agencies to be used.
 - 2. Test, Adjusting and Balancing and commissioning must occur after completion of mechanical systems, including all control calibration and adjustment, and requires substantial completion of the building, including closure, ceilings, lighting, partitioning, etc.
 - 3. Allow 21-days after test and balance for system commissioning and life safety testing (where applicable).

1.18 CUTTING AND PATCHING

- A. See Division 01 – General Requirements.

1.19 UTILITY CONNECTIONS

- A. Utilities include but are not limited to, water, sanitary sewer, storm sewer, natural gas, fire protection water, chilled water, heating water, steam, Energy Management and Control System, etc.
- B. Connect to utility company mains as required. Include all meters and other ancillary components required by serving utility company.
- C. Connect to on-site piping mains.
- D. Contractor shall be responsible for payment of all service charges.

- E. Contractor shall be responsible for provisions for temporary utilities.
- F. (Others as required).

1.20 WARRANTY

- A. In accordance with Division 1 Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows.
- B. All extended warranties specified herein shall be non-prorated.
- C. Warranty all materials, equipment, apparatus, and workmanship to be free of defective materials and faulty workmanship for a period of one year from and after date of acceptance of completed contract.
- D. Provide new materials, equipment, apparatus, and labor to replace that determined by Architect to be defective or faulty.
- E. This guarantee also applies to services including instructions, adjusting, testing, noise, balancing, etc.
- F. Refrigerant compressors to have an additional four-year parts warranty.
- G. Nothing herein intends or implies that guarantee shall apply to work which has been abused or neglected by the Owner or the Owner's successor in interest. The Contractor shall clearly identify such work and Owner requirements inside warranty documentation and at Owner training, with forms and checklist.

1.21 PERMITS

- A. Obtain all permits, certificates of inspections, patent rights and licenses that are required for the performing of this work by all laws, ordinances, rules and regulations or orders of any officer and/or body. Provide all notices necessary in connection therewith and pay all fees relating thereto and all costs and expenses incurred on account thereof. No work shall be covered before inspection by the jurisdiction authorities and observation by the Architect.

1.22 CONTINUITY OF EXISTING SERVICE AND SYSTEMS

- A. Schedule work so existing systems will not be interrupted. Obtain approval from the Owner and Architect at least 14 days prior to any utility interruption or connection.
- B. Perform work at such time and in such a manner as to cause minimum inconvenience to the Owner and as approved by the Architect. No allowance will be made for lack of knowledge of existing conditions.
- C. Existing utility service and systems:
 - 1. Protect existing active utilities.
 - 2. Relocate as indicated on Construction Drawings.
 - 3. Existing inactive utilities shall be capped or plugged (below grade).
- D. Connections to existing work:
 - 1. Install new work and connect to existing work with minimum interference to existing facilities.
 - 2. Connect new work to existing work in neat and acceptable manner. Restore existing disturbed work to original condition.

- E. Removal and relocation of existing work.
 - 1. Disconnect, remove, or relocate piping, ductwork, conduit, and other work noted or required by alterations, modifications or changes in existing construction.
 - 2. Plug or cap affected active lines behind or below finished walls and/or floors.
 - 3. Dispose of removed piping and material.
- F. Special Traffic Requirements:
 - 1. Maintain emergency and service entrances so they are usable for pedestrian, truck and emergency vehicles at all times.
 - 2. Where trenches are cut, provide adequate bridging for above-mentioned traffic.

1.23 PROVISIONS FOR FUTURE WORK

- A. The design contemplates future work. Provisions for this work are indicated on the Drawings. All work conducted as part of this contract shall be completed with the future work accounted for. Rework associated with system components installed in locations that will disrupt the future work shall be performed at no cost to the Owner.

1.24 PROCEDURE OF WORK

- A. The Contractor is hereby cautioned that although he will be permitted to conduct his work during regular working hours (see exceptions below), his work shall be performed in such a manner so as not to interfere with the conduct of regular business unless approval for such interference has been obtained from the Owner and Architect. No reimbursement shall be made to the Contractor for losses sustained due to delays and interruptions of his work to accommodate the operation and business of the Owner.
- B. Regular working hours exceptions: Extended utilities shutdowns and/or major equipment changeouts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Listed "Acceptable Manufacturers" are those considered capable of manufacturing products or equipment conforming to detailed Specifications and Schedules, and as such, are invited to compete provided the offering is comparable in every respect to scheduled or specified products and actually conforms to the detailed Specifications and Schedule requirements. Listing herein as "Acceptable Manufacturers" does not imply "Accepted", "Approved", "Prior Approval" or any other connotation. All product offerings must be submitted for approval after Contract Award.
- B. Alternate manufacturers as identified in each section will be considered under conditions specified herein.
- C. Identify materials, equipment by manufacturer's name, nameplate data. Remove unidentified materials, equipment from Site.
- D. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.
- E. Where no specific make of material or equipment is mentioned, any first-class product of reputable manufacturer may be used, provided it conforms to requirements of system and meets with acceptance.

- F. Provide an authorized representative to constantly supervise work of this Division, check all materials prior to installation for conformance with Drawings, Specifications, reviewed Submittals and reviewed Shop Drawings.
- G. Conform to conditions shown and specified. Coordinate with other trades for best possible assembly of combined Work. Relocate equipment when necessitated by failures to coordinate Work or to advise Architect of conflicts in writing.
- H. Material and Equipment-General Requirements
 - 1. New.
 - 2. Approved for use by State Fire Marshal and local building inspection department when applicable.
 - 3. Testing agency labeled or with other identification wherever standards have been established.
 - 4. Architect reserves right to reject items not in accordance with Specification either before or after installation.
 - 5. Comprised to render complete and operable systems; provide additional items needed to complete installation to realized design.
 - 6. Compatible with space allocated; modifications necessary to adjust items to space limitations at Contractor's expense.
 - 7. Installed fully operating and without objectionable noise or vibration.
 - 8. Design of mechanical systems is generally based on product of the first named manufacturers cited. Where systems for product installed necessitate modification of systems shown on drawings, Contractor is responsible for installation of systems appropriate to product installed.
- I. Electrical Requirements
 - 1. Electrical Work performed under Division 23 – Mechanical shall conform to requirements of Division 26 Electrical.
 - 2. Provide weatherproof devices and installation for out-of-doors work.

2.2 PAINTING

- A. Finish painting (other than factory applied) of mechanical equipment and associated piping and ductwork shall be as specified in Division 09 "Painting" Section(s). Provide touch up painting of prefinished mechanical products.
 - 1. All equipment, ductwork, piping conduit and associated supports, attachments, hardware, and connectors exposed to the weather shall be properly coated, painted or otherwise protected from corrosion caused by the elements (sun, wind, rain, snow, ice, etc.).
- B. Surfaces shall be left clean, debris shall be removed, and equipment shall be furnished in prime coat finish ready for finish coats.
 - 1. Piping, Ductwork and Equipment: Clean exterior of piping, ductwork and equipment removing rust, plaster and dirt by wire brushing. Remove grease, oil and similar materials by wiping with clean rags and suitable solvents.
 - 2. Motors, Pumps and Other Items with Factory Finish: Remove grease and oil and leave surfaces clean and polished.
- C. Cleaning operations may be supplemented by more detailed instructions in various other Sections of this Specification.
- D. Paint for high temperature piping and equipment shall be high temperature resistant, designed for the temperatures at which the system will operate.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that conditions are satisfactory for the installation of materials and equipment. Notify Architect if conditions are not satisfactory and do not commence work until conditions have been corrected.

3.2 INSTALLATION

- A. Install materials and equipment in compliance with governing codes.
- B. Use printed descriptions, specifications, and recommendations of manufacturers as a guide for installation of Work. Follow in all cases where manufacturers of articles used furnish directions covering points not specified or shown.
- C. Equipment.
 - 1. Assemble equipment which is required to be field assembled under the direct supervision of the manufacturers' agent.
 - 2. Prior to the final acceptance submit letters from the manufacturers that equipment has been assembled under the direct supervision of the manufacturers' agent.
 - 3. Accurately set and level equipment with supports neatly placed and properly fastened.
 - 4. Properly fasten equipment in place with bolts to prevent movement.
 - 5. Coordinate the installation of equipment with openings in structure.
 - 6. Coordinate and fully dimension steel supports for mechanical equipment, where shown on drawings with installing contractor.
 - 7. Provide all roof curbs for roof mounted fans, flues, piping and duct penetrations, etc.
 - 8. Concrete.
 - a. Concrete work, include forming, steel bar reinforcing, cast-in-place concrete, finishing, and grouting is specified under Division 03 Concrete.
 - b. Coordinate and fully dimension concrete housekeeping pads and curbs with installing contractor; dimensions shall be as required for structural requirements.
 - c. Coordinate inertia base fill with installing contractor
- D. Electrical.
 - 1. See Division 26 Electrical.
 - 2. Install electrical devices with code required clearances and access.
 - 3. Assist the electrical contractor in the proper connecting of all electrical wiring and equipment required for mechanical equipment.
- E. Sleeves, Chases and Concrete Inserts.
 - 1. Provide all required sleeves, chases, concrete inserts, anchor bolts, etc.
 - 2. Sleeves, chases are prohibited in structural members, except where shown or as directed by Architect in writing.
 - 3. Embed no piping in concrete or masonry.
- F. Waterproof Construction.
 - 1. Comply with Division 07 – Thermal and Moisture Protection.
 - 2. Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of mechanical penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls.
 - 3. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight.

4. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rainwater; this requirement applies to damper operators and bearings, damper motors, controls and instruments. See other Sections in this Division for application of this requirement to motors, drives, ducts and fans.

G. Restoration of Damage.

1. Repair or replace, as directed by Architect, materials and parts of premises which become damaged.
2. Remove replaced parts from premises at no additional cost to the Owner.

H. Review architectural drawings and coordinate with Architect and other contractors to be sure that all architectural shafts, plenums, rated duct enclosures etc. required for mechanical systems are properly located and dimensioned.

I. Access Panels and Doors.

1. Coordinate size requirements and exact location with Contractor who will install access doors.
2. Minimum Sizes: 18 inches by 18 inches unless otherwise shown on Drawings or approved by Architect.
3. Provide where shown, or required by Regulatory Agencies, for access of all concealed equipment such as terminal units, valves, fire/smoke dampers, etc., for Mechanical Work:
 - a. Equipment shall be located wherever practical over accessible ceilings or rooms to avoid access doors.
 - b. Access doors shall not be used solely for access to balancing dampers; use instead, remote control devices specified under Section 233300 – Air Duct Accessories.

J. Openings.

1. Coordinate and fully dimension all openings in walls, floors, roofs, and structural elements required for mechanical work.
2. Provide all required fire-stopping around pipe, duct and other penetrations required for mechanical work in rated partitions where required by code.
3. Fire damper openings: Contractor shall provide damper UL installation requirements to contractor installing partitions to ensure construction complies with listing.
4. Air outlet openings.
 - a. Contractor shall coordinate exact locations of air outlets in floors, walls and ceilings with contractor installing partition.
 - b. Contractor shall coordinate additional T-bar or spline required to accept air outlets with contractor providing and installing ceiling and associated materials.

3.3 PROTECTION OF EQUIPMENT AND MATERIALS DURING CONSTRUCTION

- A. See Division 01 – General Requirements.
- B. Provide protective covers, skids, plugs or caps to protect equipment and materials from damage or deterioration during construction.
- C. Store equipment and material under cover, and off the ground or floors exposed to rain.
- D. For outdoor storage, protective covers of 10 mil thick black sheet plastic shall be fitted over equipment and materials. Covers shall be reinforced to withstand wind and precipitation. Set equipment and material on skids or platforms of height to avoid damage or deterioration from spattering and ground water.

- E. Protect coils against damage by installing temporary closure panels over exposed coil faces. Panels shall be minimum 24-gauge sheet metal or 0.375" plywood.
- F. Completely cover motors and other moving machinery to protect from dirt and water during construction.
- G. Close open ends of fans, air valves, terminal units, energy recovery units, air handling units, and ductwork with temporary closures of sheet plastic taped in place.
- H. Plug ends of pipes when work is stopped to prevent debris from entering the pipes.
- I. Provide dust and debris protection for ductwork, coils, fans, equipment, motors, and bearings operated during construction up to date of substantial completion.
- J. Cover open ends of exhaust and return ducts with temporary filter media while fan systems are operating.
- K. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.
 - 1. Remove from site and provide new, duplicate, material, equipment or apparatus in replacement of that rejected.
 - 2. Any porous materials, such as duct liner, insulation or flexible ductwork that becomes wet; for example, due to rain shall be replaced; drying is not sufficient (due to possible microbial contamination).
- L. Perform Work in manner precluding unnecessary fire hazard.

3.4 ADJUSTMENT

- A. Preliminary Operation.
 - 1. Operate any portion of installation for Owner's convenience if so requested by Architect. Such operation does not constitute acceptance of Work as complete but does constitute beneficial use. Cost of utilities, such as gas and electrical power, will be borne by the Owner if operation is requested by Owner.
- B. Startup Service.
 - 1. Prior to startup, ensure that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrications, venting fan balance, controls and installed and properly set relief and safety valves. See pre-function tests in Division 23 – Mechanical.
 - 2. Start and operate all systems.
 - 3. Provide services of factory trained technicians for startup of major equipment and systems including boilers, chillers, fire pumps, etc.
 - 4. Adjusting: See Section 230593 – Testing, Adjusting and Balancing for HVAC.
 - 5. Functional Testing: See Section 230900 – Energy Management & Control Systems.
 - 6. Life Safety Testing.
 - a. Assist Division 26 Electrical contractor in testing fire alarm controls, including control of smoke dampers and shut-off of fan systems.
 - b. Correct any problems related to equipment supplied under Division 23 – Mechanical.
 - c. Complete the control matrix with details such as fan tags, FSD tags, etc. based on control matrix provided with Life Safety Report.
 - d. Assist Life Safety System commissioning agent in testing and commissioning Life Safety System.

- e. Provide all tests, air balance and start-up personnel require to start and commission the system and for assisting the design/construct team in demonstrating system compliance with the local fire district and building department.
7. Submit startup checklist and narrative from equipment manufacturer on specialized equipment as boilers, chiller, DOAS, and VRF/VRV systems.

C. Noise.

1. Cooperate in reducing any objectionable noise or vibration caused by mechanical systems to the extent of adjustments to specified and installed equipment and appurtenances.
2. Completely correct noise problems caused by failure to make installation in accordance with Contract Documents, including labor and materials required as a result of such failure, at no additional cost to the Owner.

3.5 SPECIAL TOOLS

A. Furnish to Owner at completion of work.

1. One set of any special tools required to operate, adjust, dismantle, or repair equipment furnished under any section of this Division.
2. Pressure gage and temperature sensor for piping test plug.

3.6 CLEANING

A. Cleaning.

1. See Division 01 – General Requirements.

B. Thoroughly clean equipment, fans, pumps, motors, piping and other materials under this Division free from all rust, scale and all other dirt before any covering or painting is done, or the systems put in operation; leave in condition satisfactory to Architect.

C. At all times keep the premises free from accumulation of waste material and debris caused by his employees. At the completion of the Project, and at other times as Architect may direct, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the Site of his Work clean.

D. Completely cover all plumbing fixtures and all motors and other moving machinery to prevent entry of dirt and water during construction.

E. Effectively cap all openings into ducts and pipes to keep moisture and foreign matter out during construction.

F. Clean and polish identification plates.

G. Clean equipment, ductwork, insulation, piping, conduit, and room surfaces of dust and dirt and maintain in a clean condition from date of substantial completion until final completion of work and corrective work.

3.7 PAINTING

A. Painting.

1. Piping exposed to outdoors and, where indicated elsewhere.

- a. One coat primer.
 - b. Two coat alkyd oil paint, UV resistant for PVC piping, color as indicated.
 - c. Not required for copper, galvanized steel, or insulated piping.
 - 2. Steel hangers and supports exposed to outdoors.
 - a. One coat primer.
 - b. Not required for galvanized steel.
 - 3. Interior of ductwork and duct accessories, including insulation stick pins, at air outlets as far back as visible from occupied spaces.
 - a. Flat black.
 - 4. Marred surfaces of factory painted equipment.
 - a. Spot coat to match adjacent coat.
 - 5. Insulation exposed to sunlight:
- B. Execution.
- 1. Protect flooring and equipment with drop cloths.
 - 2. Paint and materials stored in location where directed.
 - 3. Oily rags and waste removed from building every night.
 - 4. Wire brush and clean off all oil, dirt and grease areas to be painted before paint is applied.
 - 5. Workmanship.
 - a. No painting or finishing shall be done with:
 - 1) Dust laden air.
 - 2) Unsuitable weather conditions.
 - 3) Space temperature below 60 deg. F.
 - b. Pipes painted containing no heat and remain cold until paint is dried.
 - c. Paint spread with uniform and proper film thickness showing no runs, sags, crawls, or other defects.
 - d. Finished surfaces shall be uniform in sheen, color, and texture.
 - e. All coats thoroughly dry before succeeding coats are applied, minimum 24 hours between coats.
 - f. Priming undercoat of slightly different color for inspection purposes.
 - 6. Piping continuously painted in all exposed areas.
- C. Paint.
- 1. High gloss medium or long alkyd paint.
 - 2. Best grade for its purpose.
 - 3. Deliver in original sealed containers.
 - 4. Apply in accordance with manufacturer's instructions.
- D. Colors.
- 1. Colors as directed by Architect unless specified herein.
 - 2. Interior of ductwork as far back as visible from outside: flat black.
 - 3. Uncoated hangers, supports, rods and insets: dip in zinc chromate primer.

- E. Factory Finish.
 - 1. Ceiling and wall mounted air outlets in acoustical tile ceilings: Baked white enamel.
 - 2. Aluminum air outlets that are not to be painted: anodized.
 - 3. Exposed fan coil units: baked enamel.
 - 4. Unit ventilators and unit heaters: baked enamel.
 - 5. Fans, pumps, compressors, tanks and like items.
 - 6. Air handlers, pumps, water heaters and like items, where exposed.
- F. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat.
- G. Properly prepare Work under this Division to be finish painted under Division 09 – Painting.
- H. Provide moisture resistant paint for exterior painting and heat resisting paint for hot piping, equipment, and materials.
- I. For the following, provide factory prime coat. Also, provide factory finish painting on each if not specified in Painting Division.
 - 1. Other air outlets.
- J. Paint all equipment out-of-doors and equipment supports with two coats of weather resistant enamel.
- K. Protect all finished surfaces of fixtures with heavy paper pasted thereon, or by other means, throughout the period of construction.
- L. Refinish Work supplied with final finish under this Division if damaged under this Division to satisfaction of Architect.

3.8 FIELD QUALITY CONTROL

- A. See Division 01 – General Requirements (Quality Control).
- B. Tests.
 - 1. Perform as specified in individual sections and as required by authorities having jurisdiction.
 - 2. Duration as noted.
- C. Provide required labor, material, equipment and connections.
- D. Furnish written report and certification that tests have been satisfactorily completed.
- E. Repair or replace defective work, as directed by Architect in writing, at no additional cost to the Owner.
- F. Restore or replace damaged work due to tests as directed by Architect in writing, at no additional cost to the Owner.
- G. Restore or replace damaged work of others, due to tests, as directed by Architect in writing, at no additional cost to the Owner.
- H. Remedial work shall be performed to the satisfaction of the Architect, at no additional cost to the Owner, including:
 - 1. Work related to all Division 23 – Mechanical tests.
 - 2. Division 23 – Mechanical work related to Section 230593 – Testing, Adjusting and Balancing for HVAC.

- I. Remedial work shall include performing any tests related to remedial work and additional time at no additional cost to the Owner.

3.9 EXISTING EQUIPMENT AND SYSTEMS

- A. Owner has first right of refusal of all existing equipment and components indicated to be removed.
- B. Material and equipment which has been removed and not accepted by the Owner shall become the property of the Contractor and shall be removed from the site.
- C. Material and equipment which has been removed shall not be used in the new work, except as specified herein.
- D. Where existing piping, ductwork and equipment is indicated on the Drawings, its size and location shall be verified.

3.10 EQUIPMENT AND INSTALLATION REQUIREMENTS

- A. Air systems shall operate without aerodynamic noise generated from the faulty installation of ductwork or any component of the air distribution system.
- B. Equipment shall be installed and connected as specified herein or indicated on the Drawings in accordance with the manufacturers' instructions and recommendations for this Project. Furnish and install auxiliary piping, water seals, valves, and electrical connections recommended by the manufacturer for operation.
- C. Provide roughing, fittings, accessories, and connecting piping, and make final connections to all equipment. Coordinate carefully with equipment vendor prior to starting rough-in work.
- D. In unfinished areas designated for future build-out, install piping, ductwork, conduit, and equipment tight against the structure to maximize future ceiling height.
- E. Motor quantities, sizes and equipment wattage ratings specified herein or indicated on the Drawings are the minimum requirements, unless noted otherwise. Motor quantities, sizes, and equipment wattage ratings less than those specified herein or indicated on the Drawings are not acceptable. Larger motor sizes and equipment wattage ratings may only be provided, if necessary, to meet the prescriptive requirements specified herein or indicated on the Drawings. Where multiple motors or motor sizes or equipment wattage ratings larger than specified herein or indicated on the Drawings are furnished, provide and coordinate the corresponding increased number or capacity of feeders and other electrical equipment serving them, at no additional cost to the Owner.
- F. Field-installed equipment controls, or sensor wiring shall be installed in conduit. Low voltage control and sensor wiring shall be installed in conduits separate from line voltage control wiring and power wiring.
- G. Where water connection sizes at equipment vary from the pipe size indicated on the Drawings, provide appropriate reducers/increasers directly adjacent to the pipe-equipment unions. Unless otherwise specified herein or indicated on the Drawings, the size of the valves and accessories dedicated to the equipment shall not be less than the pipe size to which they are connected.
- H. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible and with the manufacturer's minimum required clearances provided. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made without written approval.

1. Group concealed valves, controls and equipment requiring access, so as to be freely accessible through access doors.

3.11 DIAGRAMS

- A. Frame and mount the following information:

Information	Location
HVAC diagrams, start-stop procedures, valve schedules, and valve location floor plans.	Appropriate mechanical rooms.
Energy Management control diagrams and sequences.	Adjacent to each control panel.
Appropriate control and interface drawings, including a simplified guide to local programming through the digital display unit, a directory of I/O points connected to that panel, and variables which may be displayed.	Posted on the inside cover of each EMCS panel.

- B. Diagrams shall be computer generated.
- C. Diagrams shall be as-built and shall include interfaces and interlocks with other equipment.
- D. Diagram framing system: 0.125" thick acrylic with satin finish aluminum frames.

3.12 MAINTENANCE

- A. Equipment operated prior to the date of substantial completion shall be maintained in accordance with manufacturer's recommendations. In addition, provide complete water treatment for hydronic and steam systems operated prior to date of substantial completion.
- B. Prepare and submit a lubrication chart listing for each piece of equipment:
 1. Points requiring lubrication.
 2. Recommendations for a single manufacturer's lubricants with brand name and designation.
 3. Frequency of lubrication required.
- C. Lubricate each item of apparatus requiring lubrication prior to start-up in accordance with the manufacturer's recommendations.

END OF SECTION 230010

SECTION 230020 - MECHANICAL CLOSE-OUT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Summary Includes

1. As-Built Drawings.
2. Operation and maintenance documentation directory.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of systems and equipment.
5. Closeout Documentation Checklists.

B. Related Sections:

1. Section 230010 – Mechanical General Provisions.
2. Section 230030 – Demonstration and Training for Mechanical Systems.

1.3 SUBMITTALS

- A. See Section 230010 – Mechanical General Provisions.

- B. Initial Submittal: Submit draft copy of each manual a minimum of 60 days prior to requesting Substantial Completion inspection. Include a complete operations and maintenance directory. Architect will return draft copy and mark whether general scope and content of manuals are acceptable.

- C. Submit manuals according to the following table.

1. "R" means required.

Item	Product Data	O&M Manual	Samples	Shop Drawing
As-Built drawings		R		
Operation and Maintenance Documentation Directory		R		
Operation Manual		R		
Systems and Equipment Maintenance Manual		R		
Closeout Documentation Checklists		R		

PART 2 - PRODUCTS

2.1 AS-BUILT DRAWINGS

- A. Maintain at job site a set of contract record documents kept current by indicating thereon all changes, substitutions, etc., between work as specified and as installed.
- B. Show on record documents actual air quantities, water flow rates, valve or damper positions after balancing, etc.; also show, by actual dimension, location of all new and known existing underground work.
- C. At the completion of the project, furnish the Owner three sets of drawings and three complete, clean sets of specifications showing installed location, size, etc., of all work and material as taken from record documents. All as-built (on record) drawings shall be labeled "As-Built Drawings," dated and certified accurate by Contractor with his signature, on front page of all Drawing sets and Specifications.

2.2 OPERATION AND MAINTENANCE MANUALS

- A. These operation and maintenance manual requirements supplement operation and maintenance manual documentation requirements of other Sections of these specifications.
- B. Operation and maintenance documentation, in hardback 3-ring loose-leaf binders except full size drawings and CDs, shall cover the HVAC and building automation systems. Documentation shall include an operations and maintenance documentation directory, emergency information, operating manual, maintenance manual, test reports, and construction documents.
- C. Initial Submittal: The operation and maintenance documentation package shall be submitted as one comprehensive package to the Owner 1 month before systems start-up, and shall be updated, revised and completed at completion of construction.
- D. Final Submittal: Provide four (4) complete manuals.
 1. Correct or modify each manual to comply with Architect's comments. Submit Final manuals shall be submitted 15 working days prior to demonstration and training of Owner's personnel. Manuals are to be used in training sessions by Owner's personnel.
- E. Compile and coordinate the documentation for equipment and systems installed. Unless otherwise indicated, organize each manual into a separate section for each system and subsystem and a separate section for each piece of equipment not part of a system. Documentation shall be typewritten and shall contain, at a minimum, the following information.
 1. Introduction:
 - a. Project name, contractors' and subcontractors' names, addresses, telephone numbers, email addresses and facsimile numbers. Indicate the portion of the work for which each subcontractor was responsible.
 - b. List of Documents.
 - c. List of systems.
 - d. List of equipment.
 - e. Table of Contents.
 2. Operations and Maintenance Documentation Directory:
 - a. Explanation of the identification system used, including lists of systems, equipment, and component identifiers and names. Use the same system, subsystem and equipment

designation as used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

3. Manual Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - a. Title page.
 - b. Warranty Page
 - c. Table of contents.
 - d. Manual contents.
4. Manual Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - a. Project name, contractors' and subcontractors' names, addresses, telephone numbers, email addresses and facsimile numbers. Indicate the portion of the work for which each subcontractor was responsible.
 - b. Subject matter included in manual.
 - c. Name and address of Project.
 - d. Name and address of Owner.
 - e. Date of submittal.
 - f. Name, address, telephone number, fax number and email address of Contractor.
 - g. Name and address of Architect and other Architects.
 - h. Cross-reference to related systems in other operation and maintenance manuals.
5. Warranty Page
 - a. Provide table as shown at end of section. Table to be on separate page in O&M. Three copies of table to be laminated and turned over to owner. All products to be listed in table.
6. Manual Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume and cross-referenced to Specification Section number in Project Manual.
 - a. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table for all volumes in each volume of the set.
7. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem and equipment. If possible, assemble instructions for subsystems, equipment and components of one system into a single binder.
 - a. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 x 11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1) If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary, to provide essential information for proper operation or maintenance of equipment or system.
 - 2) Identify each binder on front and spine, with printed title "OPERATION AND MAINTNANCE MANUAL," Project title or name, project number and subject matter contents. Indicate volume number for multiple-volume sets and six-digit Section number on bottom of spine.

- b. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the system on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - c. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 - d. Supplementary Text: Prepared on 8-1/2 x 11-inch, "20-lb" white bond paper.
 - e. Drawings: Attached reinforced, punched binder tabs on drawings and bind with text.
 - 1) If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - 2) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual or reduced drawings. DO NOT USE BINDER POCKETS. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents and drawing locations.
 - f. Provide color photographs instead of drawings where necessary to demonstrate unusual or complex installations.
8. Emergency Information:
- a. Information for technical and nontechnical personnel about actions recommended during emergency situations to protect life and property and to minimize disruption to the building occupants. Emergencies shall, at a minimum, include:
 - 1) Fire.
 - 2) Security breach.
 - 3) Water outage.
 - 4) Power failure.
 - 5) Refrigerant release.
 - 6) Heating failure.
 - 7) Cooling failure.

2.3 OPERATION MANUAL

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem and equipment descriptions.
 - 2. Performance and design criteria if Contractor is delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Valve tag lists.
 - 10. Precautions against improper use.
 - 11. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.

6. Limiting conditions.
 7. Performance curves for pumps, fans and heat exchangers.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment of system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

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

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual and annual frequencies.
 2. Maintenance and Service Record: Include manufacturer's forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of executed warranties and bonds and lists of circumstances and conditions that would affect validity of warranties and bonds.
1. Include procedures to follow and required notifications for warranty claims.
 2. Include all model, serial numbers and information required on table at end of section. Table is available in Excel upon request from Professional.

NOTE: Where manuals contain manufacturer's standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data includes more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

2.5 CLOSEOUT DOCUMENTATION

- A. Seven days prior to requesting a final inspection, the Contractor shall submit all O&M and closeout documentation to the Architect, to be submitted to the Owner at the end of the project.
- B. The checklist herein shall be utilized for compiling documentation and shall be included behind front cover of O&M manuals.
- C. Contractor shall initial and date each line item once completed and shall email a copy of the completed checklist to the Architect prior to final inspection request.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Assemble a complete set of the following manuals indicating procedures for each.
 1. Emergency manual.
 2. Product maintenance manual.
 3. Operations and maintenance manual.
- C. Manufacturer's Data: When manuals contain manufacturer's standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data includes more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- D. Drawings: Prepare drawings supplementing manufacturer's printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequences and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation. Do not use original Project Record Drawings.
1. Do not use original Project Record Drawings as part of operation and maintenance manuals.

3.2 CLOSEOUT DOCUMENTATION CHECKLIST

- A. Closeout Documentation Checklists included:
1. Division 23 – HVAC.

**CLOSEOUT DOCUMENTATION CHECKLIST
DIVISION 23 – HVAC**

Project Name:		
Initials of person completing task	Date task completed	Description of Contractor's Submittal
		Final TAB Report (3 each required).
		Signed Letter Record of Owners Personnel O & M Training.
		DVD Record of Owners Personnel O & M Training (3 each).
		Operation & Maintenance Manuals.
		As-Built Drawings with Contractor's Stamp.
		Warranty Information.
		Manufacturer's representative(s) shall provide certification(s) that HVAC equipment has been installed in accordance with manufacturer's recommendations. Typical for Boilers, Chillers, HVAC pumps and Central Station AHU's.
		Provide list of all spare air filter sets. List number, size, type and location/equipment match-up.
		Certification by Contractor that all bearings requiring periodic lubrication, as recommended by equipment manufacturer, have been initially lubricated and have been tagged. Provide a list of all equipment lubricated.
		Pipe Pressure Test Log.
		Control sequences of operation.
		On a reduced floor plan drawing, the CONTRACTOR shall indicate the location of all variable frequency drives, starters, and switches. These devices shall be properly marked to indicate equipment they serve as designated on the Contract Documents.
		Keys to access doors. (Provide written receipts with Owner's acceptance).
		Keys to control panels and sensor/controller covers (provide written receipts with Owner's acceptance).

PROJECT NAME									
Equipment Tag	Manufacturer	Model Number	Serial Number	Manufacturer Warranty Description	Start Date	End Date	Contact Information		Remarks
							Name	Phone Number	
RTU-1	NAME OF MANUFACTURER	ABC1234	ABC1234	1-year Parts Only	1/1/2020	1/1/2021	John Doe (Company)	(xxx) xxx-xxxx	
				5-year Compressor Parts Only	1/1/2020	1/1/2021	John Doe (Company)	(xxx) xxx-xxxx	
VAV Terminal Units	NAME OF MANUFACTURER	ABC1234	ABC1234	1-year Parts Only	1/1/2020	1/1/2021	John Doe (Company)	(xxx) xxx-xxxx	
EF-1	NAME OF MANUFACTURER	ABC1234	ABC1234	1-year Parts Only	1/1/2020	1/1/2021	John Doe (Company)	(xxx) xxx-xxxx	
EWH-1	NAME OF MANUFACTURER	ABC1234	ABC1234	5-year Heating Element	1/1/2020	1/1/2025	John Doe (Company)	(xxx) xxx-xxxx	
				10-year Tank	1/1/2020	1/1/2030	John Doe (Company)	(xxx) xxx-xxxx	
ODU-1	NAME OF MANUFACTURER	ABC1234	ABC1234	10-year Parts Only	1/1/2020	1/1/2030	John Doe (Company)	(xxx) xxx-xxxx	
IDU-1.01	NAME OF MANUFACTURER	ABC1234	ABC1234	10-year Parts Only	1/1/2020	1/1/2021	John Doe (Company)	(xxx) xxx-xxxx	
VRF Equipment	NAME OF MANUFACTURER	N/A	N/A	10-year Parts Only	1/1/2020	1/1/2030	John Doe (Company)	(xxx) xxx-xxxx	Includes central controller and thermostats
				2-year Labor	1/1/2020	1/1/2022	John Doe (Company)	(xxx) xxx-xxxx	Includes refrigerant and programming
HVAC Controls Actuators	NAME OF MANUFACTURER	N/A	N/A	5-year Parts Only	1/1/2020	1/1/2025	John Doe (Company)	(xxx) xxx-xxxx	

<CONTRACTOR NAME HERE> warrants and guarantees all materials, equipment and workmanship provided by our company relating to the HVAC system and Plumbing for the above referenced project.

If any parts or materials supplied by our company prove defective, we will repair or replace such items as necessary without expense to the Owner, including costs of services, materials, transportation, parts and labor.

This warranty period begins on <INSERT SUBSTANTIAL SUBMITTAL DATE> and shall run for one year from that date.

Any questions relating to warranty should be directed to our home office at <INSERT PHONE NUMBER>.

SECTION 230030 - DEMONSTRATION AND TRAINING FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Administrative and Procedural requirements for preparing operation and maintenance manuals, including the following:
1. Demonstration of operation of systems, subsystems, and equipment.
 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Sections:
1. Section 230010 – Mechanical General Provisions.
 2. Section 230020 – Mechanical Close-Out Requirements.

1.3 SUBMITTALS

- A. See Section 230010 – Mechanical General Provisions.
- B. Initial Submittal: Submit draft copy of each manual a minimum of 60 days prior to requesting Substantial Completion inspection. Include a complete operations and maintenance directory. Architect will return draft copy and mark whether general scope and content of manuals are acceptable.
- C. Submit manuals according to the following table.
1. "R" means required.

Item	Product Data	O&M Manual	Samples	Documentation
Instruction program				R
Qualification data				R
Attendance record				R
Evaluations				R
DVD				R

- D. Instruction Program: Submit to the Architect copies of instructional program outline for demonstration and training, including a schedule of proposed dates, times, length of instruction and instructors' names for each training module. Include learning objective and outline for each training.
1. At completion of training, submit two (2) complete training manuals for Owner's use.

- E. Qualification Data: Include lists of completed projects with project names and addresses, names, and addresses of Architects and Owner and other information specified.
- F. Attendance Record: For each training module, submit list of participants and length of instruction time.
- G. Evaluations: For each participant and each training module, submit results and documentation of performance-based test.
- H. Demonstration and Training DVD's: Submit two copies of each DVD within seven (7) days of recording.
 - 1. Format: Provide high quality color DVDs.
 - 2. Identification: On each DVD, provide an applied label with the following information:
 - a. Name of project.
 - b. Name and address of photographer.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Date DVD was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point) and elevation or construction story.
- I. Transcript: Prepared on 8-1/2 x 11" (A4) paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with the same label information as the corresponding DVD. Include name of Project and date of DVD on each page.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.
- B. Photographer Qualifications: An individual of established reputation who has been regularly engaged as a professional video photographer for not less than five years.
- C. Pre-instruction Conference: Review methods and procedures related to demonstration and training including, but not limited to the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections and as follows:
1. Gas-fired heating equipment.
 2. Refrigeration systems including chillers, pumps, ice storage tanks and chilled water piping.
 3. HVAC systems including air-handling equipment, heat exchangers, piping specialties, etc.
 4. Control System.
 5. Variable Frequency Drives.
- B. Training Modules (Basis of System Design, Operational Requirements and Criteria): Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following (this will be provided through the Architect):
1. System, subsystem, and equipment descriptions.
 2. Performance and design criteria.
 3. Operating standards.
 4. Regulatory requirements.
 5. Equipment function.
 6. Operating characteristics.
 7. Limiting conditions.
 8. Performance curves.
- C. Training Modules (Documentation): Review the following items in detail:
1. Emergency manuals.
 2. Operations manuals.
 3. Maintenance manuals.
 4. Project record documents.
 5. Submittal manual.
 6. Identification systems.
 7. Warranties and bonds.
 8. Maintenance service agreements and similar continuing commitments.
 9. Owner requirements to uphold extended warranties.
- D. Emergencies: Include the following as applicable:
1. Instructions on meaning of warnings, trouble indications and error messages.
 2. Instructions on stopping.
 3. Shutdown instructions for each type of emergency.
 4. Operating instructions for conditions outside of normal operating limits.
 5. Sequences for electric or electronic systems.
 6. Special operating instructions and procedures.
- E. Operations: Include the following as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Control Sequences.
 6. Safety procedures.

7. Instructions on stopping.
8. Normal shutdown instructions.
9. Operating procedures for emergencies.
10. Operating procedures for system, subsystem, or equipment failure.
11. Seasonal and weekend operating instructions.
12. Required sequences for electric or electronic systems.
13. Special operating instructions and procedures.

F. Adjustments: Include the following:

1. Alignments.
2. Checking adjustments.
3. Noise and vibration adjustments.
4. Economy and efficiency adjustments.

G. Troubleshooting: Include the following:

1. Diagnostic instructions.
2. Test and inspection procedures.

H. Maintenance: Include the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Procedures for routine cleaning.
5. Procedures for preventative maintenance.
6. Procedures for routine maintenance.
7. Instructions on use of special tools.

I. Repairs: Include the following:

1. Diagnosis instructions.
2. Repair instructions.
3. Disassembly: component removal, repair and replacement and reassembly instructions.
4. Instructions for identifying parts and components.
5. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training modules. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: The Architect will serve as facilitator to assist the Contractor in preparation of instruction program and training modules, to coordinate instructors and to coordinate between Contractor and Owner for number of participants, instruction times and location.

- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect, with at least forty-five (45) days advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.
- E. Demonstration and Training DVD: Record each training module separately. Include classroom instructions and demonstrations, board diagrams and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING DVDs

- A. Demonstration and Training DVDs: Record instruction of Owner's personnel in the operation and maintenance of equipment and systems. Edit DVDs to remove non-instructional conversation. Photographer shall select vantage points to best show equipment, systems and procedures demonstrated.

END OF SECTION 230030

SECTION 230500 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Administrative and Procedural requirements for preparing operation and maintenance manuals, including the following:
1. Temporary operation of mechanical equipment.
 2. Wall and ceiling access panels.
 3. Fire, smoke, and sound stopping.
 4. Pipe Sleeves.
 5. Escutcheons.
 6. Dielectric Fittings.
 7. Protective drip pans.
 8. Non-shrink grout.
- B. Related Sections:
1. Section 230010 – Mechanical General Provisions.

1.3 SUBMITTALS

- A. See Section 230010 – Mechanical General Provisions.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawings
Wall and ceiling access panels	R			R
Roof curbs	R			R
Fire, smoke and sound stopping	R			R
Pipe sleeves and sleeve seals	R			R
Escutcheons	R			
Dielectric fittings	R			
Protective drain pans	R			R
Non-shrink grout	R			

1.4 QUALITY ASSURANCE

- A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be paid by this Contractor for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must minimum requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work includes but are not limited to the following listed in this specification.
- B. Wall and ceiling access doors.
 - 1. Acudor.
 - 2. Williams Brothers.
 - 3. J.R. Smith.
 - 4. Or equal.
- C. Mechanical sleeve seals.
 - 1. Calpico, Inc.
 - 2. Metraflex Co.
 - 3. Thunderline/Link-Seal.
 - 4. Or equal.

2.2 WALL AND CEILING ACCESS DOORS

- A. Access panels shall be provided for all concealed valves, controls, dampers, and other mechanical equipment and devices where occasional access for adjustment or repairs will be necessary. Panels shall have cam and cylinder lock with two keys. All locks shall be keyed alike. Label panels as in accordance with Section 230553 – Mechanical Identification.
- B. Size of panels to be large enough to permit servicing or replacement of devices, controls, valves, etc.; minimum size to be 18"x18". Submit schedule with submittal package indicating location and size.
- C. General.
 - 1. Fabricate units of all welded steel construction.
 - 2. The frame and panel assembly for fire rated access panels shall be manufactured under the Factory Inspection Service of Underwriters Laboratories, Inc., and shall bear a label reading: "Frame and Fire Door Assembly, Rating 1-1/2 Hr. (B), Temperature Rise 30 Minutes, 250°F, Maximum".
 - 3. Access panels used in toilets, kitchens, and other areas expected to experience high relative humidity are to be constructed of stainless steel.
- D. Flush Access Panel for Drywall or Plaster: Model WB-DW and WB-PL.
 - 1. Body and flange shall be 16-gauge steel. Door shall be 14-gauge steel.
 - 2. Hinges shall be concealed, piano type, opening to 175 degrees. Number of hinges will vary with size of door.

3. Locks shall be flush, key operated cylinder lock. Number of locks will vary with size of door.
4. Finish shall be factory applied oven baked grey enamel with rust inhibiting phosphated undercoat.
5. Plaster models shall have 2-1/2" of 24 gauge galvanized expanded wing casting surrounding door.
6. Drywall models shall have a 1-1/8" perforated drywall bead on all four sides.

2.3 FIRE, SMOKE, AND SOUND STOPPING

- A. UL listed penetration sleeve assembly and/or firestop that meets ASTM E-814 E119, and E84, as "3M" systems or equal for the intended applications.
- B. All fire, smoke and sound stopping to be done by a licensed and certified Contractor as approved by Architect.

2.4 PIPE SLEEVES AND SLEEVE SEALS

- A. Pipe Sleeves.
 1. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
 2. PVC Pipe Sleeves: Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 3. Galvanized-Steel Sheet Metal Sleeves: Galvanized sheet metal sleeves with lock seam joints and comply with the following minimum thickness:
 - a. 24 gauge for 3 inches and smaller.
 - b. 22 gauge for 4 inches to 6 inches inclusive.
 - c. 20 gauge for sizes over 6 inches.
- B. Sleeve Seals: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Stainless steel.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.
 4. Link-Seal or equal.

2.5 ESCUTCHEONS (WALL, FLOOR, AND CEILING PLATES)

- A. Description.
 1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener in exposed applications.
 2. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
 3. Split-Casting Brass Type: With polished, chrome-plated rough-brass finish and with concealed hinge and setscrew in exposed applications.
 4. Escutcheon thickness: For wall and ceiling plates, not less than 0.025-inches for up to 3-inch pipe and 0.035-inches for larger pipe.
 5. Escutcheon thickness: For floor plates, not less than 0.094-inches.

2.6 DIELECTRIC FITTINGS

- A. Provide where copper and ferrous metal are joined.
 - 1. 2 inch and less: Threaded dielectric union.
 - 2. 2-1/2 inch and larger: Flange union with dielectric gasket and bolt sleeves.
 - 3. Temperature Rating: 210 °F for water systems.

2.7 NON-SHRINK GROUT

- A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psig, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 WALL AND CEILING ACCESS PANEL

- A. Coordinate size requirements and exact location with Contractor who will install access doors.
- B. Minimum Sizes: 18 inches by 18 inches unless otherwise shown on Drawings or approved by Architect.
- C. Provide where shown or required for access of all concealed equipment such as terminal units, valves, fire/smoke dampers, etc., for Mechanical Work. Where ceiling is constructed with removable tiles or sections, access panels are not required.
 - 1. Equipment shall be located wherever practical over accessible ceilings or rooms to avoid access doors.
 - 2. Access doors shall not be used solely for access to balancing dampers; use instead remote control, devices specified under Section 233300 – Air Duct Accessories.
- D. Contractor shall provide substantial metal angle frame and support at all ceiling access panels.

3.2 PIPE SLEEVES AND SLEEVE SEALS

- A. Install sleeves for pipes passing through exterior walls, concrete beams, foundations, footings, floors and roof decks.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exceptions:
 - 1) In areas where pipes are exposed, extend sleeves 1/4-inch above finished floor.
 - 2) Extend sleeves installed in floors of mechanical equipment areas or other wet areas (kitchens, toilets, etc.) 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into new walls, beams, foundations, footings, floors, roof decks and slabs as work progresses.

3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Pipe shall be capable of free movement within the sleeve.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Contractor shall coordinate specific sealing requirements to ensure fire, smoke or sound ratings are maintained through pipe penetration/sleeve assembly.
 - a. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- B. Interior wall pipe penetrations.
1. Galvanized-steel sheet metal sleeves.
 2. Interior openings shall be caulked tight with fire, smoke or sound stopping material and sealant to prevent the spread of fire, smoke, and sound. Contractor shall coordinate specific requirements to ensure fire, smoke or sound ratings are maintained.
- C. Above grade exterior wall, concrete beams, foundations, footings, waterproofed floors and where sleeve is extended above finished floor pipe penetrations: Seal penetrations using silicone sealant specified above.
1. Install galvanized steel or Schedule 40 PVC pipe sleeve.
- D. Below grade exterior wall pipe penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install galvanized steel or Schedule 40 PVC pipe sleeve.
 2. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- E. Sleeves that extend into return air plenums shall be of non-combustible material, either galvanized steel or Schedule 40 steel pipe sleeves.
- F. For drilled penetrations in existing floors provide one-inch angle ring flange set in silicone sealant and bolted to the floor in lieu of pipe sleeves with one-inch extension above floor.
- ### 3.3 ESCUTCHEONS
- A. Install pipe escutcheons for exposed pipe penetrations of concrete and masonry walls, wall board partitions, suspended ceilings, etc.
 - B. Inside diameter shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve and penetration.
 - C. Use plates that fit tight around insulation or pipes when not insulated.
 - D. Plates shall cover openings around pipes/insulation and cover the entire pipe sleeve projection. Use deep pattern escutcheons where required to completely conceal protruding fittings and sleeves.
- ### 3.4 DIELECTRIC FITTINGS
- A. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

- B. Wet Piping Systems: Install dielectric coupling, unions, and nipple fittings to connect piping materials of dissimilar metals.

3.5 GROUTING

- A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, pipe support base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Place grout, completely filling equipment bases and pipe support base plates.
- E. Place grout around anchors.
- F. Cure placed grout according to manufacturer's written instructions.

3.6 CUTTING AND PATCHING

- A. Do not cut into any major structural element without written approval of the Architect.
- B. Cut required openings through existing masonry or reinforced concrete with diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Architect. Locate openings that will least affect structural slabs, columns, ribs, or beams. Refer to the Architect for determination of proper design for openings through structural sections and opening layouts for approval prior to cutting or drilling into structure. After Architect's approval, carefully cut openings through construction no larger than absolutely necessary for the required installation.
- C. Patching:
 - 1. Shall be of quality and appearance matching the existing construction.
 - 2. Contractor shall restore all services and construction that remains in use, to its condition prior to Work performed as part of this contract.

END OF SECTION 230500

SECTION 230513 – MOTORS AND CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors, motor controllers (starters) and Variable Speed Drives (VSD) for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
1. Motors.
 2. Motor controllers.
 3. Variable speed drives.

1.3 SUBMITTALS

- A. See Section 230010 "Mechanical General Provisions."
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Motors	R	R		R
Belts and Drives		R		
Variable Speed Drives	R	R		R
Motor Controllers/Starters	R	R		R

- C. Submittals shall include certification from the motor manufacturer certifying compliance with NEMA MG-1, part 31 for motors that are driven by variable speed drives.
- D. Submit a site-specific harmonic analysis showing total voltage harmonic distortion and total current harmonic distortion is in compliance with IEEE 519. If the analysis indicates that additional external devices or filters are required to meet the power quality requirements of the VSD, provide the devices or filters at no additional cost to the Owner.

1.4 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.5 WARRANTY

- A. Special Warranty: VSD warranty shall be 60 months from date of start-up certification including all parts, labor, travel time, and expenses.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Motors.
 - 1. General Electric
 - 2. Gould, Inc.
 - 3. Baldor.
 - 4. Or equal.
- C. Variable Speed Drives.
 - 1. Yaskawa.
 - 2. Trane.
 - 3. ABB.
 - 4. Or equal.
- D. Motor Controllers/starters.
 - 1. ABB.
 - 2. Cerus.
 - 3. Square D.
 - 4. Or equal.

2.2 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.3 MOTORS

A. General.

1. In accordance with NEMA, IEEE, and ANSI C50 standards.
2. Capacity.
 - a. Minimum horsepower indicated.
 - b. To operate driven devices under all conditions without overload.
3. Squirrel-cage induction type, NEMA Type "B": insulation class, continuous duty.
4. Speed.
 - a. 1750 RPM, unless otherwise indicated.
 - b. See schedules on drawings for other speeds.
5. NEMA KVA locked rotor CODE LETTER: "G" or better.
6. Service factor: 1.15.
7. Type unless otherwise scheduled on Drawings.
 - a. Voltage: As scheduled on Drawings. Contractor shall verify actual site voltage prior to procurement.
 - b. 1/2 horsepower and smaller.
 - 1) Single-phase, 60 hertz.
 - 2) With built-in auto-reset thermal overload protection.
 - c. 3/4 horsepower and larger.
 - 1) Three-phase, 60 hertz.
 - 2) Motors 50 horsepower and over: Reduced voltage start, suitable for star-delta starting or as scheduled on Drawings.
 - d. EC Motors.
 - 1) Where scheduled on Drawings or equipment Specifications.
 - 2) Equal to GE ECM version 2.2 or greater.
 - 3) Programmed with fan curve for "constant airflow".
8. Bearings, unless otherwise scheduled on Drawings or equipment Specifications.
 - a. Provide motors with double shielded, grease lubricated, ball bearings, with grease pockets on each side for re-greasing in service. Provide inlet and outlet grease connections in motor housings for each bearing. Provide factory sealed permanently lubricated ball bearings on roof mounted equipment. Similar bearing may be provided on fractional horsepower motors. Provide sleeve bearings where so specified.
 - b. Ball type, unless otherwise noted.
 - c. Sealed, permanently lubricated, unless otherwise noted or not available in motor size.

B. Enclosure.

1. Open drip-proof (ODP).
 - a. Provide ODP motors unless otherwise indicated.

2. Totally enclosed (TEFC).
 - a. Motors outside the building or otherwise exposed to the weather.
 - b. Non-ventilated: under 1/2 horsepower.
 - c. Fan-cooled: 1/2 horsepower and larger.

3. See schedules on drawings for other enclosures.

C. Belt-connected motors.

1. Foundation slide base.
2. Shaft as required for aligning pulleys.

D. Motors 1 horsepower and larger shall be NEMA Premium labeled and have guaranteed efficiencies equal to or exceeding NEMA Table 12-6D.

E. Multi-speed motors.

1. Two speed motors shall be single winding 1800/900 rpm unless otherwise specified or indicated.
2. Provide 1800/1200 rpm multi-speed motors of separate winding, variable torque type, unless otherwise specified or indicated.

F. Motors driven by variable speed drives.

1. Shall meet the requirements of NEMA MG-1 part 31.40.4.2.
2. Where used for pumps or fans shall be capable of operating at 10 percent speed indefinitely.

G. Electrically Commutated Motors (EC Motors).

1. Brushless DC type with electronic commutation from 115 volt or 277-volt single phase power to a DC signal.
2. Speed controllable from a minimum of 20% or less to 100% of full speed.
3. Minimum 80% efficiency at all speeds.
4. Provide the following.
 - a. Potentiometer dial mounted on the exterior of the motor housing.
 - b. 0-10 VDC control signal input and 0-10 VDC speed feedback output with pre-wired contacts. Motor shall shut off when speed signal is below minimum.

2.4 VARIABLE SPEED DRIVES

A. All variable speed drives other than those that are factory packaged with equipment shall be supplied by one manufacturer.

B. Electrical Characteristics.

1. Efficiency shall be not less than 97 percent at rated voltage, current, and frequency and fundamental power factor shall not be less than 98 percent at all speeds and loads.
2. VSD shall maintain line noise (voltage harmonics) on the input electrical system at or below levels specified in IEEE 519 for a "General System." Manufacturer shall include in submittals a harmonic distortion analysis (IEEE 519, 3 percent) for this particular jobsite. Provide as a minimum 5% impedance line reactors. The 5% impedance may be from dual

(positive and negative DC bus) reactors or 5% AC line reactors. VSDs with only one DC reactor shall include AC line reactors.

3. VSD shall include EMI/RFI filters that allow the VSD assembly to be CE Marked and meet product standard EN 61800-3 for the First Environment restricted level.

C. Features and Accessories.

1. Plain language LCD display (code numbers not acceptable); all set-up parameters, indications, faults, warnings, and other information shall be displayed in words, not codes.
2. Displays and meters for the following: Output voltage, output frequency, motor rpm, motor current, motor watts, speed signal input, last three faults.
3. Hand-Off-Auto keyboard function with manual speed control, including bump-less transfer of speed reference when switching between Hand and Auto modes.
4. Input line fuses.
5. Adjustable or multiple carrier frequencies up to 12 kHz. Include a carrier frequency control circuit that reduces the carrier frequency based on actual VSD temperature that allows the highest carrier frequency without derating the VSD or operating at high carrier frequency only at low speeds.
6. Isolated 4-20 mA or 0-10 Vdc speed signal input. If the input reference is lost the VSD shall, based on user selectable option, either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the speed based on the last good reference received, or (4) cause a warning to be issued.
7. Analog outputs for kW and speed; kW shall be accurate to $\pm 3\%$.
8. Digital outputs for alarm and motor on/off status; latter shall be based on field adjustable motor current that can indicate broken belt or coupling.
9. Ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable for each fault type.
10. Controls.
 - a. Provide a minimum of two digital outputs that can be programmed for multiple purposes and also controlled through the DDC network interface device by the DDC system independent of other VSD functions or status. Control sequence possibilities shall include:
 - 1) Contact to open fan discharge damper either with fan start or independent of fan operation, controlled via the DDC system and wait for the damper end switch to make before starting the drive; this shall function in the normal drive mode, bypass mode, and life safety mode (if part of smoke control system).
 - b. For fans used as part of IBC smoke control system, include:
 - 1) Programmable digital input that, when external contact is closed by life safety control system, causes VSD to start and operate at a preset adjustable speed, overriding automatic speed and on/off controls, manual speed settings and all keypad and HOA commands.
 - 2) "Run to destruct" option so that when the digital input is closed, all internal and external safeties that might prevent the VSD from operating at the preset speed will be ignored or overridden.
 - c. Provide built-in PID control loop, allowing connection of a pressure or flow signal to the VSD for closed loop control.
 - d. Provide factory installed BACnet/MSTP network interface that allows all VSD control points to be communicated to EMCS. See Section 230900 "Energy Management & Control Systems." At a minimum, the following points shall be provided:

- 1) Read only: Speed feedback, output speed, current, % torque, kW power, kilowatt hours (resettable), operating hours (resettable), drive temperature, digital input status, analog input values, all diagnostic warning and fault information, keypad "Hand" or "Auto" selected, deceleration rate, and acceleration rate.
 - 2) Read/write: On/off, output speed, digital output open/close, analog output values, remote fault reset, PID setpoint and gains, force the unit to bypass, maximum speed, and minimum speed.
11. Enclosure.
- a. NEMA 3R enclosure for outdoor installation or unconditioned space.
 - b. NEMA 1 enclosure for indoor installation in conditioned space or indirectly conditioned space such as return air plenum.
 - c. UL Type 12 for wet mechanical rooms.
 - d. UL listed as plenum rated where located in supply, return, or outdoor air stream.
12. Thermostatically controlled cooling fans shall be provided where required to meet ambient operating conditions. Fans shall be designed for replacement without requiring removal of the VSD from wall mount or removal of circuit boards. Fan sound power shall be no greater than local noise sources where VSD is installed.
13. 3-contactor, constant speed bypass shall be provided to allow the motor to run across the line in the event of VFD shutdown. The transfer from the VFD to the line shall be accomplished manually by means of a selector switch. The bypass circuitry shall be enclosed in a separate well-mounted NEMA 1 cabinet. The bypass cabinet shall include a door interlocked input circuit breaker, a VFD output contactor, and a full voltage starting contactor (both contactors electrically interlocked), a thermal overload relay to provide motor protection, and a control power transformer. Mounted on the cabinet door shall be the bypass selector switch, motor fault light, power ON light, motor on VFD light, and motor online light.

D. Equipment Protection and Safeties.

1. VSDs short-circuit interrupting rating shall equal or exceed that fault current available at the drive.
2. VSD shall protect itself against all normal transients and surges in incoming power line, any grounding or disconnecting of its output power, and any interruption or run away of incoming speed signal without time delay considerations. Protection is defined as normal shutdown with no component damage.
3. The VSD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The VSD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.
4. VSD shall protect itself against all phase-to-phase or phase-to-ground faults.
5. VSD shall be able to start into a rotating load at all speeds (forward or reverse) without trip.
6. Anti-regeneration circuit shall match the deceleration rate of the drive to that of the motor to prevent high bus voltage shutdown common to high inertia loads, such as fans.
7. VSD shall ride through an input power dip of 3 cycles without trip.
8. VSD shall operate properly at a -35% +30% voltage fluctuation from rated voltage.
9. VSD shall operate properly at a 10 percent frequency variation from rated frequency.
10. VSD shall employ three current limit circuits to provide trip-free operation: slow current regulation, rapid current regulation, and current limit switch-off limit. VSD shall be designed so that overcurrent trip shall be at least 315 percent of the drive's current rating.
11. VSD shall have the ability to set a maximum current available to the motor.

12. VSD shall withstand unlimited switching of the output under full load, without damage to the VSD. Operation of a disconnect switch between the motor and VSD shall not have an adverse effect on the VSD, whether the motor is operating or not. Controls conductors between the disconnect and the VSD shall not be required for the safe and reliable operation of the VSD.
 13. The VSD shall withstand switching of the input line power up to 20 times per hour without damage to the VSD.
 14. The VSD shall be capable of operating continuously at full load in the following service conditions
 - a. Ambient temp: 30 to 104 degrees Fahrenheit.
 - b. Relative humidity: 0 to 95 percent, non-condensing.
- E. Warranty shall be 24 months from date of start-up certification including all parts, labor, travel time, and expenses.

2.5 MOTOR CONTROLLERS/STARTERS

- A. General.
1. Manual reset, Class 20, thermal type overload protection for each phase, in accordance with NEMA ICS 2-2000 (R2005).
 2. NEMA 3R enclosures for exterior application.
 3. Equipment furnished with factory-installed starters shall also be equipped with individual motor disconnect and thermal magnetic circuit breakers or fuses as specified herein with lugs sized to receive a feeder as indicated on the Electrical Drawings.
 4. 120 V secondary control power transformer with fused primary and secondary circuit in the enclosure.
 5. Unused auxiliary contacts (installed on each contactor): 1 normally open, and 1 normally closed.
- B. Motor starters shall be provided with provisions for interfacing with the Energy Management and Control System (EMCS) or other control and interlocking requirements.
1. For all magnetic starters, a minimum of one set of field reversible auxiliary contacts shall be provided with the starter.
- C. For 3-phase motors, unless otherwise specified herein:
1. Combination magnetic type and thermal magnetic circuit breaker with:
 - a. Circuit breakers having minimum AIC rating as specified in Division 26.
 - b. External operating handle capable of being locked in the off or open position.
 - c. Hand-off-automatic switch, except those manually controlled.
 - d. Starters for motors 50 hp and larger shall be solid-state, reduced-voltage type.
- D. For 1-phase, unless otherwise specified herein:
1. Manual starting switch with thermal overload protection and pilot light.
 2. Hand-off-automatic switch.
 3. Magnetic across-the-line starters with overload protection and Hand-Off-Automatic switch, except for manually controlled equipment.

- E. Provide control transformers for equipment with voltage above 240 volts, or as required for complete, operable systems.
- F. Coordinate with DIVISION 26: ELECTRICAL.
- G. Refer to individual equipment sections for factory-provided controllers.
 - 1. Installed on equipment by manufacturer.
 - 2. Supplied with equipment by manufacturer for field installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades.
- B. Install in accordance with manufacturer's written installation instructions.
- C. Drives for packaged equipment shall be mounted and wired by equipment manufacturer.
- D. Mounting and power wiring of field mounted variable speed drives and other motor controllers is specified under Division 26 Electrical:
 - 1. Where wall space is not available for mounting VSDs or other motor controllers, provide mounting struts securely mounted to the floor, roof, or adjacent structure.
 - 2. Where VSD has disconnect switch, locate VSD within sight of equipment served so that switch complies with NEC requirements.
- E. Set overload devices to suit motors provided in accordance with NEC.

3.2 INSTALLATION

- A. Verify that adequate clearance between motor, controllers and adjacent walls or equipment is available to permit maintenance and repairs.
- B. Check that motor and controller are properly supported and allows for proper alignment and tension adjustments as necessary for application.

3.3 PRE-OPERATING CHECKS

- A. Before operating motors and controllers.
 - 1. Check for proper and sufficient lubrication.
 - 2. Check for correct rotation.
 - 3. Confirm alignment and re-align if required.
 - 4. Check for proper adjustment of vibration isolation.

3.4 STARTUP, TESTING AND ADJUSTING

- A. Start and test motors and controllers in accordance with manufacturers written installation instructions.
- B. After starting motors.
 - 1. Check for high bearing temperatures.
 - 2. Check for motor overload by taking ampere reading at maximum operating conditions, with all valves open and individual motor running.
 - 3. Check for objectionable noise or vibration; correct as needed at no additional cost to the Owner.
- C. Variable speed drives.
 - 1. Certified factory start-up shall be provided. A certified start-up form shall be filled out for each VSD with a copy to the Architect and a copy kept on file by the manufacturer.
 - 2. See Section 230900 "Energy Management and Control Systems" for points to be mapped from the drive controller to the EMCS; coordinate information addresses and other information required with the Section 230900 "Energy Management and Control Systems" contractor.
 - 3. Set variable speed ramp-up rates on variable air volume systems slow enough to prevent high pressure trips and/or damage to duct systems. Coordinate with Section 230900 EMCS contractor.
 - 4. Set minimum speed for all applications in accordance with procedure indicated in Section 230900 "Energy Management and Control Systems."
 - 5. Set maximum current limit setpoint to the motor to the motor's full load amps.
 - 6. Set voltage to speed ratio (V/f) to "squared".
 - 7. For fans such as relief fans and cooling tower fans: Run fan through entire speed range and program out speeds that cause fan vibration.
 - 8. After VSD is fully configured and programmed, all settings shall be documented and included with commissioning documentation in electronic format per Section 230010 Mechanical General Provisions. The intent is to allow replacement drive electronics to be readily configured.
- D. Motor Controllers/Starters.
 - 1. Provide starters, push buttons, thermal overload switches, and contactors for equipment covered in Division 23 unless otherwise specified herein. Installation of starters, push buttons, and thermal overload switches, not factory installed, is specified under Division 23.
 - 2. Provide 120 V secondary control power transformers for control circuits where equipment is served at 208 V or higher.
- E. See Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.5 TRAINING

- A. See Section 230010 "Mechanical General Provisions."
- B. VSD manufacturer to provide one of the following:
 - 1. 8-hours of customer training.

2. Interactive Computer based training on VSD installation, start-up, programming, and trouble shooting.
3. Professionally produced video cassette on VSD installation, start-up, programming, and trouble shooting in digital format.

END OF SECTION 230513

SECTION 230529 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Equipment supports.

- B. Related Sections:
 - 1. Division 22 – Plumbing Work.

1.3 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers: ASME Section VIII – Boiler and Pressure Vessel Code – Pressure Vessels.
- B. Pipe Supports: ANSI B31.1, Power Piping.
- C. Duct Hangers: SMACNA Duct Manuals.

1.4 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports”.

1.5 SUBMITTALS

- A. See Section 230010 – Mechanical General Provisions.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. “R” means required.

2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Pipe hangers and supports	R	R		R
Structural attachments	R			R
Pipe protection and thermal hanger shields	R	R		R
Equipment supports	R			R
Expansion shields	R			
Welding certificates	R			

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Hangers, Inserts and Supports.
1. Unistrut.
 2. Superstrut.
 3. B-Line Systems.
 4. Or equal.
- C. Pipe Protection and Thermal Hanger Shields.
1. Pipe Shields, Inc.
 2. Elcen Metal Products Company
 3. Superstrut.
 4. Or equal.
- D. Expansion Shields.
1. Hilti Fastening Systems.
 2. ITT Phillips Drill Co.: Red Head.
 3. Omark Industries, Inc.
 4. Or equal.
- E. Pipe Stand Supports.
1. B-Line Systems, Inc.
 2. Grinnell Corp.
 3. PHD Manufacturing, Inc.
 4. Or equal.
- F. Powder-Actuated Fastener Systems.
1. Hilti Fastening Systems.

2. ITW Ramset/Red Head.
3. MasterSet Fastening Systems, Inc.
4. Or equal.

G. Insulation Protectors.

1. B-Line Systems, Inc.
2. ITT Grinnell Corporation.
3. PHD Manufacturing, Inc.
4. Or equal.

H. Roof Pipe Supports.

1. MiFab.
2. B-Line Systems, Inc.
3. Miro.
4. Or equal

I. Miscellaneous Devices.

1. Kopty.
2. Wejit.
3. Or equal.

2.2 PIPE HANGERS AND SUPPORTS

A. Model numbers are Superstrut, unless otherwise indicated.

B. Provide electro-chromate, galvanized or factory painted finish; no plain, "black" hangers allowed.

C. Dielectric Isolators: All uninsulated copper tubing systems; Superstrut isolators or equal, Cush-A-Strip or Cush-A-Clamp on all pipe clamps; for individual hangers, use felt lined hangers.

D. Individual Pipe Hangers.

1. Cold pipe all sizes: Clevis hanger, No. C710.
2. Hot pipe sizes up to 4 in: Clevis hanger, No. C710.
3. Hot pipe sizes above 6 in: Adjustable steel yoke and cast iron, roll No. C729.

E. Multiple or Trapeze Hangers.

1. Factory channel.
 - a. 12-gauge thick steel.
 - b. Single or double section.
 - c. Electro-chromate finish.
 - d. Strutnuts: Series A-100 or CM-100.
 - e. Straps: Series 702.
 - f. No. A-1200 or A-1202.
2. Hot pipe sizes 6 in and larger: cast iron roll and stand; C728 or CR728.

F. Wall Supports.

1. Pipe sizes up to 3 in: Steel bracket No. C738.
2. Pipe sizes 4 in and larger: Welded steel bracket C-735.
3. Hot pipe sizes 6 inches and larger.
 - a. Welded steel bracket No. C739.
 - b. Adjustable steel yoke and cast iron, roller No.C729.

G. Vertical Support.

1. Riser clamp Series C-720.

H. Floor Support.

1. Hot pipe sizes up to 4 inch; cold pipe, all sizes.
 - a. Adjustable cast iron saddle No. R786.
 - b. Locknut nipple.
 - c. Floor flange.
2. Hot pipe sizes 6 in and larger: Adjustable cast iron roll and stand No. R-730-C.

I. Thermal Hanger Shields (for insulated pipe supports).

1. 180-degree high density insert.
 - a. 100 psi waterproofed cellular glass, asbestos-free, K=0.38, encased in a 360-degree galvanized sheet metal shield, ASTM A653.
 - b. See Section 230719 Piping Insulation.
 - c. Same thickness as adjoining pipe insulation.
2. 180-degree galvanized sheet metal shield (inverted saddle).
 - a. Shield length and gauges.

Pipe Size	Shield Length	Minimum Gauge
1/2-1 1/2	4	26
2 - 6	6	20
8 - 10	9	16

3. Insert to extend one inch beyond metal shield ends on insulated piping.
4. Use double layer shield on bearing surface for:
 - a. Roller hangers.
 - b. Support spacing exceeding 10 feet.

J. Pipe Isolators.

1. Hanger with felt padding.
2. Tolco Fig. 3F or equal felt lined hangers.

K. Anchors and Guides: Provide anchors and guides where indicated on the Drawings and as required. Structural inserts shall be high density cellular glass. Guide slide pads shall be Teflon. Ensure that slide accommodates pipe movement over full range of service and out-of-service temperatures. Guides shall be Pipe Shields, Inc. Model #B3000 or equal. Anchors shall be Pipe Shields, Inc. Model #C4000 or equal. See Section 230719 Piping and Equipment Insulation.

L. Insulated Pipe Strap.

1. 1/2 in to 1 in plumbing piping in wood frame construction.
2. Felt insulated.
3. Kopty or equal.

M. Escutcheons: See Section 230500 – Basic Mechanical Materials and Methods.

N. Flashing and Sleeves.

1. Flashings.

- a. See Division 7 – Thermal and Moisture Protection.
- b. Flash and counter flash watertight all pipe and duct penetrations of roofs and exterior walls.
- c. Flash pipes through roofs with ITWBuildex Dektite or equal.
- d. Flash vents through roofs with.
 - 1) Minimum 24-gauge soldered roof jack for flat surface roofs.
 - 2) Minimum 4-pound lead soldered roof jack for roofs other than flat surface roofs.
 - 3) Vandal caps.
 - 4) Provide counter-flashing sleeves and storm collars.
 - 5) Caulk counterflashing and storm collar weather tight.
 - 6) Other flashings shall be minimum 24-gauge galvanized sheet metal.

2. Sleeves.

- a. See 230500 – Basic Mechanical Materials and Methods.
- b. For insulated piping, sleeve diameter shall not be less than diameter of insulation.
- c. Terminate sleeves flush with walls, and ceiling.
- d. For exposed vertical pipe, extend sleeves 1 inch above finished floor except where escutcheons are required.
- e. Packing through fire rated partitions one of following.
 - 1) 3M Penetration Sealing Systems (PSS 7909) and 3M Fire Barrier Caulk and Putty.
 - 2) Dow-Corning LTV Silicone foam.
 - 3) Or equal.
3. Separate piping through walls, other than concrete walls, from contact with wall construction materials; use non-hardening caulking.
4. Install insulation on piping in walls which require insulation at time of installation.

2.3 DUCT HANGERS AND SUPPORTS

A. See Section 233113 – Metal Ducts.

2.4 DUCT AND PIPE SUPPORT AT ROOF LEVEL

- A. The Contractor shall coordinate pipe work and ductwork to provide access to all equipment. The services at roof level indicated on the details provide the minimum clearance required for pipe work and ductwork for maintenance of the roof. The plans indicate higher elevations where necessary for access. Where pipe work and ductwork cross over at the same point, the pipe work shall run underneath the ductwork. The Contractor may propose a combined structure, for approval, to support the pipes and ducts at roof level. The contractor shall provide calculations by a certified licensed engineer in the state of Mississippi once the conceptual support has been approved. The main path of egress shall be maintained clear at 7'-6".

2.5 STRUCTURAL ATTACHMENTS

- A. Model Numbers are Superstrut, unless otherwise indicated.
- B. All components shall have galvanized or equal finish.
- C. Anchor Bolts: Size as specified for hanger rods.
- D. Concrete Inserts.
 - 1. Malleable iron.
 - 2. Place reinforcing steel through insert as recommended by manufacturer for recommended loads.
 - 3. No. 452 or equal.
- E. Beam Clamps.
 - 1. All with U-568 safety strap.
 - 2. All with locknuts on.
 - a. Set Screw.
 - b. Hanger rod.
 - 3. Bottom flange attachment.
 - a. Loading 150-pound and less: U-563.
 - b. Loading 150-pound to 300-pound: U-562.
 - c. Loading more than 300-pound: U-560.
 - 4. Top flange attachment.
 - a. Permitted only when bottom flange attachment cannot be used.
 - b. Loading 400-pound and less: M-777.
 - c. Loading more than 400-pound: M-778.
- F. Welded Beam Attachments: No. C-780 or equal.
- G. Side Beam Attachments: No. 542 or equal.
- H. Hanger Rods.
 - 1. ASTM A575 Hot rolled steel, galvanized.
 - 2. ANSI B1.1 Unified Inch Screw Threads.

3. Threaded both ends, threaded one end, or continuous threaded.
- I. Hanger Rod Fixtures.
 1. Turnbuckles: No. F-112 or equal.
 2. Linked Eye Rod.
 - a. Rod swivel.
 - b. No. E-131 or equal.
 3. Clevis: No. F-111 or equal.
 - J. Expansion Shields.
 1. Carbon-steel anchors, zinc coated.
 2. Stainless steel for corrosive atmospheres.
 3. For normal concrete use.
 - a. Self-drilling anchor.
 - b. Sleeve anchor.
 - c. Stud anchor.
 4. For thin concrete use: wedge anchor.
 5. For brick or concrete block use: sleeve anchor.
 6. Maximum load safety factors.
 - a. Static loads – 4.
 - b. Vibratory loads - 8 – 10.
 - c. Shock loads - 8 – 10.
 7. Size to suit hanger rods.
 8. ITT Phillips Red Head or equal.
 - K. Steel Deck Inserts.
 1. Factory stud with.
 - a. Clip.
 - b. Spring.
 - c. Coupling.
 2. ITT Phillips Red-Head or equal.
 - L. Miscellaneous Metal.
 1. Steel plate, shapes, and bars: ASTM A36.
 2. Steel pipe columns: ASTM A53, Schedule 40, black.
 3. Bolts and nuts: regular hexagon-head type, ASTM A307, Grade A.
 4. Lag bolts: square head type, Fed. Spec. FF-B-561.
 5. Plain washers: round, carbon steel, Fed. Spec. FF-W.92.

2.6 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A36/A36M, steel plates, shapes, and bars, black and galvanized.
- D. Concrete: Normal weight concrete (145 pcf) using Type I Portland Cement, 1" maximum size coarse aggregate to provide a minimum 28-day compressive strength of 3000 psi.
- E. Grout: ASTM C1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and nongaseous.
 - 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPE HANGERS, SUPPORTS AND GUIDES

- A. General.
 - 1. Assure adequate support for pipe and contents.
 - 2. Provide adjustable hangers for all pipes complete with inserts, adjusters, bolts, nuts, swivels, all-thread rods, etc., except where specified otherwise.
 - 3. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping.
 - 4. Except as otherwise indicated for exposed continuous pipe runs, install hangers, and supports of same type and style as installed for adjacent similar piping.
 - 5. Install all cast iron piping in accordance with Cast Iron Soil Pipe Industry (CISPI) Standards.
 - 6. Support all piping within 2 feet of each change of direction on both sides of fitting.
 - 7. Thermal hanger shields shall be provided at hangers and supports where piping is insulated.
 - 8. Prevent vibration or swaying.
 - 9. Provide for expansion and contraction.
 - 10. Supports of wire, rope, wood, chain, strap perforated bar or any other makeshift device not permitted.
 - 11. Comply with applicable requirements at ANSI B31.1 and B31.2 for piping.
 - 12. Support piping independently so that equipment is not stressed by piping weight or expansion.
 - 13. Hangers and supports shall have minimum safety factor of five (5), based on ultimate tensile or compressive strength, as applicable, of material used, base calculations on equipment's heaviest operating weight and pipes full of water.

14. Install additional supports or braces if, during normal operation, piping should sway, crawl or vibrate. Piping shall be immobile.
15. Install thrust blocks as required to prevent sway.

B. Horizontal piping, except as noted.

1. Adjustable clevis type and rod; all services at or below 250 degrees F.
2. Rollers or slide bases: not required.
3. Trapeze hangers; guide individual pipes on trapezes with 1/4-inch U-bolt or Superstrut 702 pipe clamp.
 - a. Install thermal hanger shield at each support point.
4. Galvanized sheet metal shields between hangers and PVC piping.
5. Threaded steel rods.
 - a. 2-inch vertical adjustment with 2 nuts each end for positioning and locking.
 - b. Size to 12-inch inside pipe size (IPS).

Pipe, IPS	Rod
to 2 inch	3/8 inch
2-1/2 inch and 3 inch	1/2 inch
4 inch	5/8 inch
6 inch and 8 inch	3/4 inch
10 inch and 12 inch	7/8 inch
14 inch and 18 inch	1 inch
20 inch and 30 inch	1-1/4 inch

- c. Size above 12-inch IPS and multiple pipe standards: safety factor of 5 on ultimate strength on area.
- d. For double rod hangers: 1 size smaller than above.

C. Vertical piping.

1. Base support.
 - a. Base elbow or welded equivalent.
 - b. Bearing plate on structural support.
2. Guides.
 - a. At every third floor but not to exceed.
 - 1) 25 feet for piping to 2-inch.
 - 2) 36 feet for piping 2-1/2 inch to 12-inch.
 - 3) 50 feet for piping 14 inch and larger.
 - b. Or as otherwise designed by the Vibration Isolation vendor.
3. Top support.
 - a. Special hanger or saddle in horizontal connection.
 - b. Provisions for expansion.

4. Intermediate supports: steel pipe clamp at floor.
 - a. Bolted and welded to pipe.
 - b. Extension ends bearing on structural steel or bearing plates.
5. For multiple pipes: coordinate guides, bearing plates and accessory steel.

D. Horizontal insulated piping.

1. Install saddles for rollers or slide bases.
2. Install thermal hanger shields for all other types of supports.
3. See Section 230719 Piping and Equipment Insulation for insulation connection to shields.

E. Vertical insulated piping.

1. Install thermal hanger shields at guides.
2. See Section 230719 Piping and Equipment Insulation for insulation connection to shields.

F. Install Pipe Isolators between hangers and piping for all uninsulated copper tubing.

G. Miscellaneous Steel.

1. Provide miscellaneous steel members, beams, brackets, etc., for support of work in this division unless specifically included in other divisions.

H. Fire-stopping.

1. At pipe penetrations through rated assemblies.
2. Commercial pipe sleeve assemblies that are UL listed and that have been approved by the fire marshal for this purpose.

I. Roof pipe supports shall be installed per manufacturer's recommendations in coordination with the roofing system and company holding the roof warranty.

3.2 PIPE SUPPORT SPACING

A. Maximum spacing for horizontal piping.

Type of Pipe	Size	MAXIMUM SPACING
Steel	1-1/2 inch and smaller	7 feet
	2 inch and larger	10 feet
Copper	3/4 inch and smaller	5 feet
	1- 1-1/4 inch	6 feet
	1-1/2 - 3 inch	8 feet
Plastic	4 inch and larger	10 feet
	3/4 inch and smaller	3 feet
	1" – 1-1/2"	6 feet
	1-1-1/4 inches	6 feet
	1½"-3"	8 feet
	4 inch and larger	10 feet

- B. Spacing Notes: Additional supports at:
 - 1. Changes in direction.
 - 2. Branch piping and runouts over 5 feet.
 - 3. Concentrated loads due to valves, strainers, and other similar items.
 - 4. At valves 4 inch and larger in horizontal piping, support piping on each side of valve.
- C. Parallel piping on trapezes.
 - 1. Maximum spacing to be that of pipe requiring closest spacing.

3.3 ATTACHMENT TO STRUCTURE

- A. Concrete.
 - 1. Use inserts for suspending hangers from reinforced concrete slabs, walls, and sides of reinforced concrete beams wherever practicable.
 - 2. Set inserts in position in advance of concrete work.
 - 3. Provide reinforcement rod in concrete for inserts carrying.
 - a. Pipe over 4-inch.
 - b. Ducts over 60 inches wide.
 - 4. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
 - 5. Where inserts are omitted, install hangers with expansion shields.
 - 6. Through-deck support.
 - a. Drill through concrete slab from below.
 - b. Provide rod with recessed square steel plate and nut above slab.
 - 7. Where permitted by Owner and only for revisions made after initial construction, powder actuated anchors or expansion shields may be used in lieu of inserts.
 - a. In bottom of thick slabs.
 - b. In thin slab construction, only in sides of beams.
 - 8. Pre-Cast Concrete.
 - a. Use pre-set inserts.
 - b. Where inserts are not available, field drill through beam or joists at locations as directed by Architect.
 - c. Through bolt side beam bracket to beam or joist.
 - 9. Poured-In-Place Concrete.
 - a. With metal form or underdeck.
 - b. Before concrete is poured.
 - 1) Field drill hole through metal deck.
 - 2) Provide bearing plate, nut, and locknut on rod; or install factory-made steel deck inserts specified hereinbefore.
 - c. After concrete is poured.

- 1) Install hangers with expansion shields.
- B. Steel Beam Anchors.
 - 1. Beam or channel clamps.
 - 2. Do not cut or weld to structural steel without permission of structural engineer.
- C. Steel Deck Anchors.
 - 1. Concrete filled: as specified above.
 - 2. Decking without concrete.
 - a. Through rod Support.
 - 1) Weld to square plate, 1/4 in thick.
 - 2) Plate to distribute load over minimum of two full cells.
 - 3) Coordinate with floor layouts to clear cells with wiring.
- D. Side Wall Supports.
 - 1. Concrete walls: As specified for hangers.
 - 2. Stud Walls.
 - a. Toggle bolts.
 - b. Stud welded to structural studs.
- E. Support Spreaders.
 - 1. Install spreaders spanning between structural members when hangers fall between them, and hanger load is too great for slab or deck attachment.
 - 2. Spreaders may be one of methods listed below, or combination of both as required.
 - a. Fabricated from structural channel.
 - 1) End fittings bolted or welded.
 - 2) Secure to structural members.
 - a) As required by construction.
 - b) As reviewed by Structural Engineer.
 - b. Formed channels with fittings, Superstrut or equal.
 - 1) Submit manufacturer's calculations for installation.

3.4 DUCT HANGERS AND SUPPORTS

- 1. See Section 233113 Metal Ducts.

3.5 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

- B. Grouting: Place grout under supports for equipment and floor pipe supports. Finish shall provide a smooth bearing surface.

3.6 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.7 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.8 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230553 – MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment nameplates.
 - 2. Access panel and door markers.
 - 3. Pipe markers.
 - 4. Duct markers.

1.3 REFERENCE STANDARDS

- A. Pipe marker shall comply with ANSI A13-1.

1.4 SUBMITTALS

- A. See Section 230010 – Mechanical General Provisions.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Pipe markers	R		R	
Duct markers	R		R	
Equipment tags	R		R	

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.6 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
 - 1. Brimar Industries, Inc.
 - 2. Seton Identification Products.
 - 3. Marking Services, Inc.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Labels:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: Principal lettering shall be 1/2 inch. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
 - 9. Label Content: Include equipment's Drawing designation or unique equipment number, serial number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- B. Warranty Label:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: Principal lettering shall be 1/2 inch. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Label Content: Include warranty information including start date, end of parts and labor warranty date, contact name and contact number. Coordinate information with professional and end user before making labels.

- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 ACCESS PANEL AND DOOR MARKERS

- A. Access panel and access door markers:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Red.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: Principal lettering shall be 1/2 inch. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label access panels and access doors identifying "Fire Damper, Fire/Smoke Damper", etc.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or shaped pipe markers at least three times letter height and of length required for label.

- B. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.5 DUCT LABELS

- A. Not required.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces, of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment (including motor starters, VFDs, control panels, etc.)
- B. Locate equipment labels where accessible and visible.
- C. Install access panel markers with screws on equipment access panels.

3.4 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Within 18" of each valve, valve assembly and control device.
 2. Within 3' of each 90-degree elbow, connection to equipment or vessel and where pipe enters shafts and penetrates outside walls, floors, ceilings, and non-accessible enclosures.
 3. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 4. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.

5. At access doors, manholes, and similar access points that permit view of concealed piping.
 6. Near major equipment items and other points of origination and termination.
 7. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 8. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:

Service	Pipe marker	Background color	Lettering
Natural gas	Natural gas	Yellow	Black
Storm drain	Storm drain	Green	White
Condensate drain	Condensate drain	Green	White

3.5 VALVE SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Balancing Air Systems:

- a. Operational testing and adjusting of air handling equipment.
 - b. Balancing of air distribution systems.
 - c. Testing and adjustment of air terminal devices.

- 2. Testing, adjusting, and balancing existing systems and equipment.

- a. Adjust all existing HVAC systems to the air flows provided on the original construction drawings (to be provided to the TAB Agency after contract award.)

- 3. Witnessing and certification of duct air leakage tests.

- 4. Control system verification.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.

- B. BAS: Building automation systems.

- C. NEBB: National Environmental Balancing Bureau.

- D. TAB: Testing, adjusting, and balancing.

- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 SUBMITTALS

- A. See Section 230010 – Mechanical General Provisions.

- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

- 1. "R" means required.

- 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
AABC or NEBB certification	R			
Report forms	R			
List of instrumentation	R			
Final air balancing report		R		

C. Final Test & Balance Report.

1. At least 15 days prior to Contractor's request for final inspection, submit electronic copy of final reports on approved reporting forms, and certifications for review and approval by Architect. Once approved, provide required quantity of paper and electronic copies per 230010 "Mechanical General Provisions."
2. Form of final reports.
 - a. Fully completed report forms for all systems specified to be tested and balanced including at a minimum all data specified herein to be recorded.
 - b. Each individual final reporting form must bear:
 - c. Identify instruments of all types that were used and last date of calibration of each.
 - d. Certifications.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC or NEBB.
 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. Prior to start of testing, adjusting, and balancing, verify that required Project conditions are met:
 1. System and control system installation is complete and in full operation.
 2. All pre-functional tests have been performed.
 3. Equipment has been started and tested in accordance with manufacturer's installation instructions.
 4. Doors and windows are in place and closed or under normal traffic conditions.
 5. Proper mostly clean air filters are in place.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT REVIEW

- A. Construction Review.
 1. Make on-site visits during progress of construction: Number and timing of visits to be as required to perform the functions specified below.
 2. Purpose of review.

- a. Identify potential problem for performing total system balance.
 - b. Identify modifications that will affect air total system balance.
 - c. Schedule and coordinate total system balance with other work.
 - d. Identify conditions that could create hazardous environment for building occupants.
3. Typical activities.
- a. Check that necessary balancing and measuring hardware is:
 - 1) In place.
 - 2) Located properly and accessibly.
 - 3) Installed correctly.
 - b. Identify and evaluate variations from system design.
 - c. Record data from equipment nameplates.
 - d. Identify and report possible restrictions in systems, such as:
 - 1) Closed fire dampers.
 - 2) Long runs of flexible duct.
 - 3) Poorly designed duct fittings.
 - 4) Questionable piping connections.
 - 5) Others as may arise or based on Agency's experience.
 - e. Identify best location for duct Pitot tube traverses.

1.7 FIELD 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.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified herein. If not otherwise noted, the following minimum requirements apply.
 - 1. Voltmeter: plus, or minus 1 percent scale.
 - 2. Ammeter: plus, or minus 1 percent scale.
 - 3. Ohmmeter: plus, or minus 0.1 percent scale for calibrating plus or minus 0.4 degrees Fahrenheit resistance temperature sensors, plus or minus 0.25 percent scale for calibrating plus or minus 1-degrees Fahrenheit temperature sensors, plus or minus 1 percent scale for measuring motor current.
 - 4. Other flow sensors: plus, or minus 2 percent of reading.
 - 5. Watt meter, plus, or minus 1/2 percent scale: 3 phase split core current transducers.
 - 6. Temperature: plus, or minus 0.4 degrees Fahrenheit.
- B. All equipment shall be calibrated within 6 months of use, or according to the manufacturer's recommended interval, whichever is shorter, and when dropped or damaged. Calibration tags shall be affixed or certificates readily available and proof of calibration shall be included reports.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate with work of other trades.
- B. Coordinate all work with Commissioning Coordinator.
 - 1. See Commissioning Specifications.
- C. Report to Professional any discrepancies or items not installed in accordance with the Contract Drawings pertaining to proper balance and operation of air and water distribution systems.
- D. Perform testing, adjusting, and balancing in accordance with AABC or NEBB standards.
- E. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to Section 230713 "Duct Insulation" and Section 230719 "Piping and Equipment Insulation."
- F. Mark equipment settings with paint or other suitable, permanent identification material, including damper control positions, valve indicators, and similar controls and devices, to show final settings.

3.2 AIR SYSTEMS BALANCING

- A. General.
 - 1. Do not operate fan systems for test or balance until spaces served have been cleaned of dust and debris, to avoid contamination of supply air or return air paths and equipment.
 - 2. Filters.
 - a. Check that proper specified filters are installed, oriented in the proper airflow direction, free of bypass, and clean.
 - b. Make no adjustment for dirty filters, fans were selected for clean filters at design airflow.
 - c. Adjust airflows to within 5% of scheduled quantities.
 - 3. Coordinate balancing of dampers for minimum ventilation.
- B. Air Outlets.
 - 1. Adjust diffusers' throw pattern, grilles and registers to pattern indicated on the Drawings. Review manufacturer's instructions for proper diffuser blade or weir gate positions to provide this throw pattern as it is not always intuitive. It is TAB agency's responsibility to adjust throw patterns for all adjustable throw diffusers. If diffuser has a fixed throw pattern and is incorrectly installed, HVAC contractor shall correct pattern prior to balance.
 - a. Ceiling diffusers: As indicated on the Drawings.
 - 1) Star pattern diffuser deflectors shall be adjusted for corner blow pattern unless otherwise indicated on Drawings.

- b. Double-deflection grilles: Adjust rear blades horizontal 22 degree upward and splay front blades in 45-degree pattern at each end gradually rotating to almost straight at blades in center of grille.
 - c. Floor grilles: Not applicable.
 - 2. Test and adjust each diffuser, grille and register to within plus or minus 10 percent of design requirements.
 - a. Start with all dampers wide open.
 - b. Adjust dampers, starting with nearest to terminal unit or fan. Make adjustments using duct mounted volume dampers rather than dampers at diffuser face (if any) unless absolutely required.
 - c. At least one damper shall remain wide open at end of balance.
 - 3. Plenum return air grilles or slots in lights: No balance required.
 - 4. Report.
 - a. Tag each grille, diffuser and register and mark tag on copy of floor plan.
 - b. For each grille, diffuser, and register, indicate tag, size, type, and effective area (where applicable).
 - c. Required velocity/cubic feet per minute.
 - d. Initially tested velocity/cubic feet per minute.
 - e. Finally tested cubic feet per minute after adjustments.
- C. Packaged Equipment Air Flow Rate Readings (New DOAS Unit and Existing Split Systems).
- 1. Total supply air quantities shall be determined at all of the following where applicable:
 - a. Pitot traverse in the supply duct downstream, positive pressure side of the fan.
 - b. Pitot traverse at coil or filter bank.
 - c. Totaling the readings of individual air outlets.
 - 2. Total return air quantities shall be determined at all of the following where applicable:
 - a. Pitot traverse in the return air duct or damper entering air handler.
 - b. Totaling the readings of individual air outlets if ducted return system.
 - 3. Outside air quantities shall be determined by all of the following where applicable:
 - a. Subtracting pitot traverses of supply and return ducts.
 - b. Pitot traverse of outdoor air intake duct.
 - c. Note: Balance by measurement of return air, outside air, and mixed air temperatures shall not be used due to inherent inaccuracy.
- D. Existing Exhaust Fans.
- 1. See herein for air outlet balancing.
 - 2. Total air quantities for fan shall be determined by both:
 - a. Pitot tube traverse of main ducts near the fan inlet, and.
 - b. Totaling the readings of individual air outlets (or inlets).
 - 3. Total air quantities shall be obtained within 10 percent of design by adjustment of fan speed.

- a. Constant speed fans:
 - 1) Adjust sheaves on fans with adjustable sheaves.
 - 2) Change sheaves on fans with fixed sheaves.
 - 3) Adjust speed potentiometer for EC motors.
 - b. Variable speed fans:
 - 1) Adjust maximum fan speed at ECM or VFD.
4. Report.
- a. Tag.
 - b. Manufacturer and model of fan and motor.
 - c. Sheave data at motor and fan; belt data.
 - d. Motor horsepower, rpm, volts, phase, full load amps.
 - e. Fan airflow rate at all locations measured, as listed above.
 - f. Final measured amps.
 - g. Inlet and outlet static pressure.

3.3 TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.4 TRAINING OWNER PERSONNEL

- A. Go over the final Testing, Adjusting and Balancing Report, explaining the layout and the meanings of each data type.
- B. Discuss any outstanding deficient items in control, ducting, piping, or design that may affect the delivery of air or water.
- C. Identify and discuss any systems or system components that are not meeting their design capacities.
- D. Discuss any temporary settings and steps to finalize them for any areas that are not finished or fully occupied.
- E. Any other appropriate points that may be helpful for facilities operations, relative to testing, adjusting, and balancing of the mechanical systems.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Ducts and plenums, thermal insulation.
 - 2. Duct liner.
- B. Related Sections:
 - 1. Section 230719 Piping and Equipment Insulation.

1.3 REFERENCE STANDARDS

- A. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C177 – Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- C. ASTM C335 – Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- D. ASTM C585 – Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe.
- E. ASTM C921 – Properties of Jacketing Materials for Thermal Insulation.
- F. ASTM E84 – Surface Burning Characteristics of Building Materials.
- G. ASTM E96 – Water Vapor Transmission of Materials.
- H. NFPA 255 – Surface Burning Characteristics of Building Materials.
- I. SMACNA – HVAC Duct Construction Standards - Metal and Flexible.
- J. UL 723 – Surface Burning Characteristics of Building Materials.
- K. ASTM E 814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

1.4 DEFINITIONS

- A. Duct Dimensions.

1. Duct sizes indicated on Drawings shall be clear inside dimensions unless duct size is specifically indicated as outside dimensions (OD).

1.5 QUALITY ASSURANCE

A. Source Quality Control.

1. Service: Use insulation specifically manufactured for service specified.
2. Labeling: Insulation labeled or stamped with brand name and number.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.6 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Duct insulation, wrap and liner	R			
Jackets	R			
Adhesives and coatings	R			
Mechanical fasteners	R			
Installer qualifications	R			

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Insulation: fiberglass.

1. Owens-Corning Fiberglass Corporation.
2. Johns Manville.
3. Certainteed Corporation.
4. Knauf.
5. Or equal.

C. Adhesives.

1. Childers Brand; H. B. Fuller Construction Products.
2. Foster Brand; H. B. Fuller Construction Products.
3. Mon-Eco Industries, Inc.
4. Or equal.

D. Mechanical Fasteners.

1. AGM Industries, Inc.
2. Miracle Adhesives Corporation.
3. Grip-Nail.
4. Or equal.

2.2 GENERAL

- A. Energy Codes: The current versions of ASHRAE 90.1 shall govern where requirements for thickness exceeds thickness specified.
- B. All insulation materials, including jackets, facings, adhesives, coatings, and accessories are to be fire hazard rated and listed by Underwriters' Laboratories, Inc., using Standard UL 723 (ASTM E-84), (NFPA-255), (ASA A2.5-1963).
1. Flamespread: maximum 25.
 2. Fuel contributed, and smoke developed: maximum 50.
 3. Flameproofing treatments subject to deterioration from moisture or humidity are not acceptable.
- C. Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin, shall not react corrosively with equipment, piping or ductwork, and shall be asbestos free: Duct lining shall meet ASTM C1136 and ASTM C665 for biological growth in insulation

2.3 MATERIALS

- A. Duct Wrap with Vapor Barrier, Type DW-V.
1. Insulation: ASTM C553 and C612; flexible, noncombustible blanket.
 - a. Installed 'K' ('Ksi') value: ASTM C518, 0.27 at 75 degrees Fahrenheit.
 - b. Maximum service temperature: ASTM C411, 250 degrees Fahrenheit.
 - c. Maximum moisture absorption: 0.20 percent by volume.
 2. Vapor Barrier Jacket - factory installed. (FSK).
 - a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - b. Moisture vapor transmission: ASTM E96 Procedure E; 0.02 perm.
 - c. Secure with pressure sensitive tape.
 3. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based, adhesive.
 - a. Flexible fiberglass wrap

- 1) Supply Air: 2.2" Nominal Thickness with Installed R-Value 6.0 (0.75 pcf)
 - 2) Return/Outside/Exhaust Air: 1.5" Nominal Thickness with Installed R-Value 4.2 (0.75 pcf)
 - b. Installed conductance: 0.27 BTU-inch/hr./square foot/degree Fahrenheit.
 - c. Factory applied jacket.
 - 1) Foil-scrim-kraft laminate: Aluminum foil facing.
 - 2) Glass scrim reinforcing.
 - 3) Kraft paper backing.
 - d. Maximum vapor permeance: 0.02 perms,
4. Owens-Corning All Service Faced Duct-Wrap or equal.
- B. Rectangular Duct Liner, Type AL.
1. Material.
 - a. Insulation: ASTM C423.
 - b. 'K': ASTM C518, 0.23 at 75 degrees Fahrenheit.
 - c. Maximum service temperature: 350 degrees Fahrenheit.
 - d. Maximum moisture absorption: 0.20 percent by volume.
 - e. Thickness per Duct Insulation Type and Thickness Schedule.
 - f. 1-1/2 pounds per cubic foot unless shown otherwise to be 3 pounds per cubic foot.
 - g. Installed conductance: 0.25 BTU-inch/hr./square foot/degree Fahrenheit.
 2. Interior air side surface.
 - a. Smooth black neoprene or matte facing overlay on air side. Coating shall conform to NFPA 90A, ASTM C665, ASTM G21.
 - b. Suitable for velocity up to 4000 feet per minute.
 - c. Meet erosion test method described in UL publication No. 181.
 - d. Durable and mechanically cleanable.
 - e. EPA registered anti-microbial agent.
 - f. Certainteed Toughgard Duct Liner or equal.
 - g. Adhesives.
 - 1) Duct Insulation, Internal: Foster 85-60 or equal.
 - 2) Weld Pins: Duro-Dyne CP or equal.

PART 3 - EXECUTION

3.1 DUCT & PLENUM INSULATION

- A. Duct Insulation Type and Thickness Schedule.

<u>Location</u>	<u>Cooling or Heat/Cool Supply</u>	<u>Return/Outdoor</u>	<u>Exhaust</u>
		<u>Air</u>	
Unconditioned spaces supply/return ductwork concealed in ceiling or return air plenum	1 inch AL and 2.2 inches DW-V	1 inch AL and 2.2 inches DW-V	1 inch AL and 2.2 inches DW-V
Outdoor duct	See Section 233115	See Section 233115	See Section 233115
Air distribution devices, not factory insulated (backpans of grilles, registers, and diffusers). Tape insulation to grille backpan or ceiling grid.	2.2 inches DW-V	2.2 inches DW-V	2.2 inches DW-V

3.2 DUCT INSULATION INSTALLATION

A. General.

1. Ensure that insulation is continuous through all walls.
2. Finish insulation neatly at hangers, supports and other protrusions.
3. Locate insulation joints or cover seams in least visible locations.
4. Where ducts run in groups too close to be individually insulated and finished.
 - a. Completely fill all spaces between ducts with rigid or flexible insulating material.
 - b. Insulate and finish exterior surfaces of group as specified for particular service.
5. Where ducts cannot be insulated after erection, insulate prior to installation.
6. Where specified thickness of insulation and/or lining exceeds available thickness in single layer, provide insulation and/or lining in 2 or more layers with joints staggered.
7. Preparation:
 - a. Do not install covering before ductwork and equipment has been tested and reviewed.
 - b. Ensure surface is clean and dry prior to installation.
 - c. Ensure insulation is dry before and during application.
8. Mechanical fasteners:
 - a. Use spot weld anchors in all shop fabricated internally lined ducts.
 - b. Adhered anchors.
 - c. Clip off pin penetrations flush with insulation surface or facing.
 - d. Seal pins and washers where pins penetrate vapor barriers.
 - 1) With 4-inch square pieces of vapor barrier material to match facing.
 - 2) Adhere with vapor-seal adhesive.
 - e. Spacing on rectangular ducts.
 - 1) Typical of horizontal and vertical, unless otherwise specified.
 - 2) Duct board.
 - a) 3 inches in from edges.
 - b) Intermediate fasteners: 12 inches on center maximum spacing all directions.

c) Not less than four pins per surface.

3) Duct Wrap.

Side Dimension	Maximum Spacing
24 inches and under	None required.
25 to 32 inches	Horizontal - none. Vertical: 1 row centered, 12 inches on center
33 to 48 inches	2 rows, 12 inches on center.
49 to 60 inches	3 rows, 12 inches on center.
61 inches and over	16 inches on center, all directions.

4) Duct wrap spacing applicable to flat surfaces of flat oval ducts.

9. Provide 24-gauge sheet metal Z section frames over edges of duct and plenum lining.

- a. At access openings and doors.
- b. Along edges exposed to air flow.

B. Rectangular Duct Wrap.

- 1. Vapor barrier and sealing continuous without breaks. Vapor proof seal around supports and bracing.
- 2. 2 inches lap strip at one end.
- 3. Peel insulation for 2-inch lap strip along longitudinal joints.
- 4. Seal lap strips with vapor-seal adhesive; Foster's 85-60 or equal.

C. Round Duct Wrap.

- 1. Adhere flexible insulation to ductwork with adhesive applied in 6-inch-wide strips on 16-inch centers.
- 2. Provide 16-gauge annealed tie wire tied, spiral wound or half hitched at 16-inch centers.
- 3. Overlap insulation 2 inches and seal joints and breaks with 2-inch lap of foil adhered over joint.
- 4. Apply duct wrap with vapor barrier as specified above for rectangular ducts.

D. Rectangular Duct and Plenum Lining.

- 1. Comply with SMACNA Duct Liner Application Standard, published recommendations of manufacturer, and following:
- 2. Apply adhesive over 100 percent of surfaces to be lined.
- 3. The coated surface shall face air stream.
- 4. Surface adjacent to air flow, including at joints, to be uniformly flat.
- 5. Insulation on floors of plenums and large ducts where access is required shall be protected by wire mesh so that lining is not damaged when walked or crawled on.
- 6. Blank-Off Panels: Insulation, enclosed with sheet metal on all sides; all joints with vapor barrier mastic and taped.
- 7. Volume Dampers: Where volume dampers do not allow for continuous insulation, terminate insulation clear of handle sweep and finish edges to maintain vapor barrier and to prevent damage to the insulation.
- 8. Seal butt joints and exposed edges of liner to prevent erosion.
- 9. Edges at terminal points shall be provided with metal beading and heavily coated with adhesive.
- 10. Damaged areas replaced or heavily coated with adhesive.

11. Mechanical fasteners.

- a. Use weld pins.
- b. Install mechanical fasteners.
 - 1) Weld pins flush with liner surface. Weld pins spaced maximum of 12-inch on center in both directions and within 2 inches of all corners and joints, except where SMACNA Standard requires closer spacing.
 - 2) Within 2 inches of all edges.
 - 3) Minimum 4 pins per side.
 - 4) For field alterations of lined ducts, install adhesive and glued pins with washers. Clip-off pins after washers installed. Field installed pins shall be used for unusual conditions only and shall not exceed 1 percent of total pins.

3.3 PENETRATION THROUGH RATED WALLS

- A. Refer to drawings for penetrations of rated assemblies.
- B. Install per manufacturer's installation and listing requirements.

3.4 FIELD QUALITY CONTROL

- A. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.
- B. All vapor barriers shall be continuous; tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape.
- C. See Section 233113 – Metal Ducts for protection of lined duct during construction.

END OF SECTION

SECTION 231123 – FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes materials, equipment, fabrication, special-duty valves, specialties, and installation for the following:
 - 1. Natural gas piping.

1.3 PROJECT CONDITIONS

- A. Site Gas System Pressure: (CONTRACTOR SHALL VERIFY).
- B. Building Gas System Pressure: Primary pressure is 2 psig reduced to secondary pressure of 8 Inch of Water Column. (CONTRACTOR SHALL COORDINATE WITH SUBMITTED GAS-FIRED EQUIPMENT AND EXISTING EQUIPMENT).

1.4 SUBMITTALS

- A. See Section 230010 – Mechanical General Provisions.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. “R” means required.
 - 2. “R2” means required only for products and equipment differing for the specified manufacturer and model and for “or equals” where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Piping (below ground and above ground)	R			R
Valves, all types	R			R
Meters	R	R		R
Pressure regulators	R			R
Specialties	R	R		R

1.5 QUALITY ASSURANCE

- A. FM Standard: Provide components listed in FM's Fire Protection Approval Guide if specified to be FM approved.

- B. IAS Standard: Provide components listed in IAS's Directory of AGA and CGA Certified Appliances and Accessories if specified to be IAS listed.
- C. UL Standard: Provide component listed in UL's Gas and Oil Equipment Directory if specified to be UL listed.
- D. ANSI Standard: Comply with ANSI Z223.1 and NFPA 54 (2009 Edition), "National Fuel Gas Code."

1.6 COORDINATION

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Using Agency or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than seven days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Appliance Connector Valves.
 - a. Conbraco Industries, Inc.: Apollo Div.
 - b. Mueller Co.: Mueller Gas Products Div.
 - c. Watts Industries, Inc.: Water Products Div.
 - d. Brass Craft Manufacturing Co.
 - e. American Valve.
 - 2. Gas Valves, NPS 2 and smaller.
 - a. Nibco, Inc.
 - b. Flow Control Equipment, Inc.
 - c. Grinnell Corp.
 - d. Honeywell, Inc. Co.
 - e. Crane Valves.
 - f. McDonald: A.Y. McDonald Mfg. Co.
 - g. Milwaukee Valve Co., Inc.
 - h. Mueller Co.: Mueller Gas Products Div.
 - i. Watts Industries, Inc.: Water Products Div.
 - 3. Plug Valves, NPS 2-1/2 and larger.
 - a. Walworth Co.
 - b. Olson Technologies, Inc.; Homestead Valve Div.
 - c. Milliken Valve Co., Inc.
 - 4. Appliance Pressure Regulators.

- a. Eaton Corp.: Controls Div.
- b. Harper Wyman Co.
- c. Maxitrol Co.

2.2 PIPING MATERIALS

- A. Steel Pipe: ASTM A 53; Type E or S; Grade B (Grade A for pipe 1-1/2 inch and smaller) Schedule 40; black.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
 - 2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
 - 3. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
 - 4. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
 - 5. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
 - 6. Joint Compound and Tape: Suitable for natural gas.
 - 7. Steel Flanges and Flanged Fittings: ASME B16.5.
 - 8. Gasket Material: Thickness, material, and type suitable for natural gas.
- B. Transition Fittings: Type, material, and end connections to match piping being joined.

2.3 SPECIALTY VALVES

- A. Valves, NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
- B. Valves, NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
- C. Appliance Connector Valves: ANSI Z21.15 and IAS listed.
- D. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig minimum pressure rating.
- E. Gas Valves, NPS 2 and Smaller: ASME B16.33 and IAS-listed bronze body and 125-psig pressure rating.
 - 1. Tamperproof Feature: Include design for locking.
- F. Plug Valves, NPS 2-1/2 and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.
 - 1. Tamperproof Feature: Include design for locking.

2.4 PRESSURE REGULATORS

- A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.
 - 1. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

2. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 3. Line Pressure Regulators: ANSI Z21.80.
 4. Appliance Pressure Regulators: ANSI Z21.18. Regulator may include vent limiting device, instead of vent connection, if approved by Architect.
- B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31.

3.2 INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install 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 adjacent to machines to allow service and maintenance.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- J. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels if valves or equipment requiring maintenance is concealed behind finished surfaces.
- K. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- L. Install sleeve seals for piping penetrations of concrete walls and slabs.

- M. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 PREPARATION

- A. Close equipment shutoff fuel gas to premises or section of piping. Perform leakage test as specified in Article entitled, Field Quality Control, to determine that all equipment is turned off in affected piping section.
- B. Comply with ANSI Z223.1, paragraph entitled, Prevention of Accidental Ignition.

3.4 PIPING APPLICATIONS

- A. Flanges, unions, transitions, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, provided compliance with the IFGC is maintained.
- B. Fuel Gas Piping above ground: Use the following:
 - 1. NPS 2 and Smaller: Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints.

3.5 VALVE APPLICATIONS

- A. Appliance Shutoff Valves for Pressure 0.5 psig or less. Appliance connector valve or gas stop.
- B. Appliance Shutoff Valves for Pressure 0.5 to 2 psig: Gas stop or gas valve.
- C. Piping Line Valves, NPS 2 and Smaller: Gas valve.
- D. Piping Line Valves, NPS 2-1/2 and Larger: Plug valve or general-duty valve.

3.6 PIPING INSTALLATION

- 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 dry-seal 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.
- D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.
1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves above ceilings.
 2. In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside partitions or hollow walls.
 3. In Walls: Gas piping with welded joints and protective wrapping specified in "Protective Coating" Article in Part 2 may be installed in walls, subject to approval of authorities having jurisdiction.
 4. Prohibited Locations: Do not install gas piping in or through circulating air ducts, chimneys or gas vents (flues), ventilating ducts, or elevator shafts.
 - a. Exception: Accessible above-ceiling space specified above.
- I. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- J. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings and in floor channels, unless indicated to be exposed to view.
- K. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- L. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- M. Connect branch piping from top or side of horizontal piping.
- N. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

- O. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.
- P. Install pressure gage upstream and downstream from each line pressure regulator.
- Q. Install flanges on valves, specialties, and equipment having NPS 2-1/2 and larger connections.
- R. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
- S. Purging Pipes and Fittings: A combustible gas indicator shall be used when purging mains and piping. When purging gas from abandoned lines, the air and the gas must be discharged aboveground and directed away from power lines or structures. When purging air from new lines, installation of a 3/4 service saddle and non-corrodible riser is required four (4) feet from each dead-end on all new installations of pipe in order to purge air from all dead-ends simultaneously. Release gas into new lines at a rate that will prevent formation of a hazardous mixture of gas and air or precede natural gas with a slug of inert gas.

3.7 HANGERS AND SUPPORTS

- A. Refer to Section 230529 – Hangers and Supports.

3.8 CONNECTIONS

- A. Install piping adjacent to appliances to allow service and maintenance. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.
- B. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.
- C. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
 - 2. Do not use gas pipe as grounding electrode.

3.9 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator and specialty valve.
 - 1. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator and specialty valve.
 - 2. Refer to 230553 – Mechanical Identification.
- B. Label piping per 230553 – Mechanical Identification.

3.10 PAINTING

- A. Use materials and procedures in Division 09 – Painting.
- B. Paint exterior pipe, fittings, pressure regulators, specialty valves, etc.
 - 1. Pipe and Fittings, Color: Yellow (Confirm color with Architect prior to painting).
 - 2. Pressure Regulators, Specialty valves, Etc., Color: Red (Confirm color with Architect prior to painting).
- C. Paint exposed interior pipe, fittings, pressure regulators, specialty valves, etc.
 - 1. Pipe and Fittings, Color: Yellow (Confirm color with Architect prior to painting).
 - 2. Pressure Regulators, Specialty valves, Etc., Color: Red (Confirm color with Architect prior to painting).

3.11 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to ANSI Z223.1, Part 4 "Inspection, Testing, and Purging" and requirements of authorities having jurisdiction. Isolate pressure reducing valves and equipment controls during testing. Test pressure to be 100 psi for a period of 24 hours with no drop in pressure.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect.
- D. Verify capacities and pressure ratings of pressure regulators, valves and specialties.
- E. Verify correct pressure settings for pressure regulators.
- F. Verify that specified piping tests are complete.

3.12 ADJUSTING

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

Natural Gas Piping Test Log						
Date	System	Description of Piping Section Tested	Test Press. (psig)	Test Duration (hours)	Results Pass/Fail	Witness (Contractor) Initials
This form shall be completed and submitted with the project closeout documents. Contractor shall copy this form if more sheets are required. Piping pressure test log shall be kept at project site and shall be made available to the Architect upon request.						

END OF SECTION 231123

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Ductwork.
 - 2. Fasteners, sealants, and gaskets.
 - 3. Hangers and supports.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ASHRAE - Handbook of Fundamentals; Duct Design.
 - 2. ASHRAE - Handbook of HVAC Systems and Equipment; Duct Construction.
 - 3. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
 - 4. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - 5. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 6. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - 7. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
 - 8. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
 - 9. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
 - 10. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
 - 11. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
 - 12. SMACNA – HVAC Duct Construction Standards.
 - 13. SMACNA – Rectangular Industrial Duct Construction Standards.
 - 14. SMACNA – Round Industrial Duct Construction Standards.
 - 15. SMACNA – HVAC Air Duct Leakage Test Manual.
 - 16. UL 181 - Factory-Made Air Ducts and Connectors.
 - 17. Engineering Design Manual for Air Handling Systems, United McGill Corporation (UMC).

18. Assembly and Installation of Spiral Ducts and Fittings, UMC.
19. Engineering Report No. 132 (Spacing of Duct Hangers), UMC.
20. AWS D1.1 American Welding Society Structural Welding Code.

1.4 DEFINITIONS

- A. Seam: locks or weld applied longitudinally to close section of duct, for example longitudinal seam, spiral seam.
- B. Joint: abutting connection between duct sections for continuity of air passage, for example cross joint, transverse joint, coupling.
- C. Reinforcement: hardware applied to strengthen duct, for example girth angles, tie rods, fasteners (not connectors), and the like.
- D. Stiffening: folding, bending, beading, cross breaking or corrugating of sheets to achieve strength through shape, for example pocket lock secures joint and is transverse stiffener, with girth angle and fasteners applied (not connectors), joint or stiffener is reinforced.
- E. Duct Classification:
 1. Pressure classification: except as indicated on the Drawings:
 - a. Low Pressure: Ductwork systems up to 2-inch w.g. positive or negative static pressure with velocities less than or equal to 1500 fpm.
 - b. Medium Pressure: Ductwork systems over 2-inch w.g. and up to 6-inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.
 - c. High Pressure: Ductwork systems over 6-inch w.g. and up to 10-inch w.g. positive or negative static pressure with velocities greater than 2500 fpm.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements.
 1. Entire ductwork system, including materials and installation, installed in accordance with NFPA 90A.
 2. Ductwork and components shall be listed as U.L. 181, 181A and 181B, Class I air duct, flame rating not to exceed 25 and smoke rating not to exceed 50.
 3. Flues shall conform to the requirements of NFPA-211. Products shall be listed to UL-103 and shall carry the appropriate UL listing mark or label.

1.6 SUBMITTALS

- A. See Section 230010 Mechanical General Provisions.
- B. Submit product data, O&M data, and samples and show item on shop and coordination drawings according to the following table.
 1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

C. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Ductwork materials and fittings	R			R
Duct fasteners, sealants, and gaskets	R			
Flexible duct	R			R

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Spiral oval and round ducts:

1. United Sheet Metal Division, United McGill.
2. Semco Manufacturing, Inc.
3. Eastern Sheetmetal.
4. Lindab, Inc.
5. Or equal.

C. Duct Connection Systems:

1. Ductmate Industries, Inc.
2. Fabriduct Transverse Duct Connection system.
3. Ward Industries, Inc.
4. Or equal.

D. Flexible Connections:

1. Ventfabrics.
2. Duro Dyne.
3. Or equal.

E. Flexible Ducts:

1. Thermaflex.
2. Hart & Cooley.
3. Flexmaster.
4. Or equal.

F. Duct Sealants:

1. Foster Products Corporation.
2. Hardcast Corporation.
3. 3M.
4. Or equal.

- G. Flexible Duct Clamps:
1. Panduit.
 2. Dura-Dyne.
 3. Young Regulator Company.
 4. Or equal.
- H. Hi-efficiency & conical Tap Fittings:
1. Flexmaster.
 2. Crown.
 3. Die Stamp.
 4. Or equal.

2.2 APPLICATIONS

- A. Ductwork systems shall be constructed in accordance with the following Materials as a minimum standard. Refer to Drawings for any deviation from this Table.

AIR SYSTEM	MATERIAL	SMACNA DUCT PRESSURE CLASS ⁽¹⁾	SMACNA DUCT SEAL CLASS ⁽³⁾
Supply and Return Systems:			
Single Zone AHU Supply	Galvanized Steel	2" w.g.	A
Exhaust Systems:			
Exhaust Air Device to Exhaust Distribution	Galvanized Steel	-2" w.g.	A
Exhaust Air Distribution	Galvanized Steel	-2" w.g.	A

- B. Table Notes:

1. Positive pressure unless noted otherwise in Table.
2. Air device connections may be made with insulated flexible duct as specified herein.
3. Seal Class A Sealing Requirements: Seal all transverse joints, longitudinal seams, and duct wall penetrations. Longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections oriented perpendicular to airflow. Duct wall penetrations are openings made by any screw fastener, pipe, rod or wire. Spiral lock seams in round and flat oval duct need not be sealed. All other connections are considered transverse joints, including but not limited to taps and other branch connections, access door frames and jambs, duct connections to equipment, etc.
4. Verify minimum pressure classification per NFPA 96 requirements.
5. Applies to exhaust system for general laboratory exhaust, fume hoods, and biosafety cabinets. Refer to Drawings for construction of any additional exhaust systems.

2.3 MATERIALS

- A. General Material Requirements.

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. (Minimum duct thickness shall be 24 gauge). Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2. All duct sizes shown on the Drawings are clear inside dimensions. Allowance shall be made for internal lining, where specified, to provide the required free area.
3. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched) and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for future connections/phases, otherwise plastic covers are acceptable.

B. Galvanized Steel Sheet Metal:

1. Prime, cold rolled soft galvanized steel sheets.
2. Each sheet shall be stenciled with manufacturer's name and gauge.
3. ASTM A653 and A924.
4. Galvanizing: 1-1/4 ounces per square foot, total both sides.
 - a. General: G-90.
 - b. Exposed to weather: G-90.
 - c. Plenum walls and blank-offs where in contact with cooling coil: G-90.
5. Lock-forming quality.

C. Miscellaneous Products.

1. Screws and rivets:
 - a. Same material as sheet, except as indicated on the Drawings.
 - b. On aluminum sheets, provide cadmium plated or stainless steel.
 - c. Zinc or cadmium plated, permitted on galvanized sheets.
 - d. Minimum screw size: No. 10.
 - e. Minimum rivet size: 4-pound.
2. Duct Sealants:
 - a. Sealing compound: UL-181 listed, water based:
 - 1) Foster Safetee Duct Sealant 32-19.
 - 2) Childers CP-146.
 - 3) Hardcast Products Group Flex-Grip 550.
 - 4) Or equal.
 - b. Rolled Elastomeric Duct Sealant: Hardcast Products Group Foil Grip 1403-181BFX, or equal, UL 181 listed.
 - c. Gaskets:
 - 1) Continuous, reinforced, inert self-conforming type.
 - 2) 1/8 inch thick.
 - 3) Width: to match angle connection.
 - 4) 3M Weatherban Ribbon Sealant PF5422 or equal.
 - d. Two-Part Hard-Setting Joint Tape:
 - 1) Two-part process includes tape and hard setting sealant.
 - 2) Mineral impregnated woven fiber tape.
 - 3) Impregnated with activator/adhesive of polyvinyl acetate type.
 - 4) UL Listed.
 - 5) Flame spread: 10.

- 6) Smoke contributed: 0.
- 7) Equal to Hardcast RTA-50 sealant and DT-5400 4-inch tape.

3. Spring Fasteners:

- a. Oval head stud and receptacle.
- b. Screwdriver slot.
- c. Self-ejecting.
- d. Dzus or equal.

4. Angles, tie rod and shapes for reinforcing ducts: In accordance with SMACNA HVAC Duct Construction Standards, except as indicated on the Drawings.

5. Duct connection system:

- a. Transverse bolted duct joints.
- b. Flanges with permanent, non-hardening sealant.
- c. Ductmate Industries Ductmate 25 and 35, Fabriduct TDC, or equal.

D. Flexible Connections:

1. Conforming to NFPA 701, UL Standard No. 214 and NFPA 90A.
2. SMACNA HVAC Duct Construction Standards, except as indicated on the Drawings.
3. With metal edges at each end: No. 24 USSG galvanized steel. Double lock joint.
4. Length of fabric connections.

- a. Minimum: 4-inch.
- b. Maximum: 10-inch.

5. Materials:

- a. Coated glass fabric.
- b. Flame spread rating: 25.
- c. Smoke development rating: 50.
- d. 30 ounces per square yard.
- e. Sewed and cemented seams.
- f. Indoors:
 - 1) Neoprene.
 - 2) Ventfabrics, Inc. Ventglas or equal.
- g. Outdoors:
 - 1) Weather-resistant.
 - 2) Fiberglass with Hypalon.
 - 3) UV, sunlight, and ozone resistant.
 - 4) Ventfabrics, Inc. Ventlon or equal.

E. Turning Vanes:

1. Galvanized steel ductwork: galvanized steel or painted black steel, except as indicated on the Drawings.
2. Other ductwork: same material as ductwork.
3. Construction per SMACNA HVAC Duct Construction Standards for:
 - a. Double wall vanes.

- b. Vane length: Provide separate equal size sections for vane length greater than those indicated in referenced Standards.
 - c. Vane runners: Type 1 or 2 acceptable.
 - 4. Vane radius:
 - a. 2 inch radius: duct width up to 36 inches.
 - b. 4-1/2 inch radius: duct with 36 inches or larger.
 - 5. Vane shall be at the correct angle for airflow (leading edge in line with the entering duct section; leaving edge in line with existing duct section). If only 45° angles are available, turning vanes shall only be used in 90° elbows where the entering width equals the exiting width; all other elbows shall be full radius type unless otherwise indicated on the drawings.
- F. Conical Taps: Low-pressure round take-off fittings in rectangular duct:
- 1. Heavy 26-gauge G-90 Galvanized Steel Body
 - 2. (1") 26-gauge G-90 Galvanized Steel Flange
 - 3. Double Sided Adhesive Gasket on Flange
 - 4. Extra Heavy 24-gauge G-90 Galvanized Steel Blade
 - 5. 3/8" Square Axle Secured to Blade with U-bolts (2 U-bolts used for 8" diameter and larger)
 - 6. Nylon bushings on thru and end (all sizes)
 - 7. 2" Stool with Locking Quadrant and Handle (all sizes, wing nuts not acceptable)
 - 8. Sealed on all Seams
 - 9. BO3 (2") Build-out, 3/8" Square Shaft (solid rod), U-bolt, Locking Quadrant, Handle
 - 10. Flexmaster CBD-SOG-BO3 UT 3000G, Crown 3210-DS2 or equal.

2.4 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS (LOW PRESSURE)

- A. Duct Classification: Ducts shall be considered low pressure when design velocities are 1500 fpm or less and maximum static pressure is 2-inch W.G., positive or negative.
- B. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized sheet metal, according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 - 2. Materials: free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inches thick or less, with more than 10 square feet of unbraced panel area, unless ducts are lined.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal

Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- F. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- G. Bullhead tees are not permitted.

2.5 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS (LOW PRESSURE)

- A. Duct Classification: Ducts shall be considered low pressure when design velocities are 1500 fpm or less and maximum static pressure is 2-inch W.G., positive or negative.
- B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- D. Factory-fabricated spiral lock seam duct:
 - 1. Snap-lock is not acceptable.
 - 2. Factory-fabricated longitudinal seam acceptable for ducts larger than standard factory sizes.
 - 3. Round Duct Flanges: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances. All flanges to be factory mounted.
 - 4. Flat Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
- E. Fittings:
 - 1. Same material, gauge thickness and construction as duct in which installed.
 - 2. Full body fittings are acceptable.
 - 3. Elbows:
 - a. Seams:
 - 1) 4 inch and higher pressure, class and all ducts exposed to occupant view: continuously welded seams.
 - 2) 1 inch to 3 inch pressure: spot welded with bonded (sealed) seams.
 - b. Gores:
 - 1) 2 gores - less than or equal to 30 degrees.
 - 2) 3 gores - 31 degrees through 45 degrees.
 - 3) 4 gores - 46 degrees through 60 degrees.

4) 5 gores - over 61 degrees

Type	Pressure	Location	Fittings	Traverse Joints	Branches	Couplings
Round	< 2"	Concealed	Factory Fabricated	Conical/ 45° Entry	Loose Saddle Tap Field Installed	Slip ≤ 20" Flanges > 20"
	< 2"	Exposed	Factory Fabricated	Conical/ 45° Entry	Factory Installed	Slip ≤ 20" Flanges > 20"
Oval	< 2"	Concealed	Factory Fabricated	Conical/ 45° Entry	Factory Installed	Slip ≤ 20" Flanges > 20"
	< 2"	Exposed	Factory Fabricated	Conical/ 45° Entry	Factory Installed	Slip ≤ 20" Flanges > 20"

2.6 FLEXIBLE DUCTS

A. General Requirements:

1. Flexible ducts shall be used for supply air ducts only (not acceptable for return, exhaust, relief, outdoor, etc. air ducts).
2. UL 181, Class I Air Duct.
3. Labeled for compliance with IMC.
4. Class 1 Air Duct, NFPA 90A and 90B, BOCA, SBBC, HUD/FHA, MIN Property Std.
5. Maximum flex duct length 5'-0" (five feet), installed with no more than 90 degrees of bend to diffusers and grilles. Where longer duct runs or more bends are necessary, provide rigid round ductwork.

B. Type 1 Acoustical Insulated

1. Minimum working pressure:
 - a. 10" w.g. positive
 - b. 5" w.g. negative, 16" diameter
 - c. 1" w.g. negative, 18" & 20" diameter
2. Rated Velocity
 - a. 5,550 fpm
3. Acoustic Performance:
 - a. Minimum insertion loss (dB) for 6' of 8" diameter flexible duct for flow velocities less than 2,500 fpm.
 - b. Acoustical testing to be performed in accordance with ASTM E477 and ADC Test Code FD 72-RI by ETL

	<i>Sound Power Levels, dB re. 10⁻¹² Watts, at Octave Band Center Frequency, Hz</i>					
	<i>125</i>	<i>250</i>	<i>500</i>	<i>1000</i>	<i>2000</i>	<i>4000</i>
<i>Insertion Loss</i>	<i>5</i>	<i>16</i>	<i>17</i>	<i>18</i>	<i>16</i>	<i>11</i>

4. Duct Fabric:

- a. Polyethylene fabric. Fabric to be mechanically locked to the duct helix without the use of adhesives
5. Duct Helix
- a. Corrosive resistant galvanized steel. Helix is to be mechanically formed to attach the duct fabric without the use of adhesives.
6. Vapor Barrier
- a. Fire retardant, reinforced aluminum.
 - b. (.05) perm A.S.T.M. E96, Procedure A
7. Insulation
- a. Factory insulation jacket, factory wrapped. R8 minimum.
8. Flexmaster Type 1M or equal.
- C. Type 6 Acoustical Insulated (in locations as indicated on schedules/plans)
- 1. Minimum working pressure:
 - a. 6" w.g. positive
 - b. 5" w.g. negative, 16" diameter
 - c. 1" w.g. negative, 18" & 20" diameter
 - 2. Rated Velocity
 - a. 5,550 fpm
 - 3. Acoustic Performance:
 - a. Minimum insertion loss (dB) for 6' of 8" diameter flexible duct for flow velocities less than 2,500 fpm.
 - b. Acoustical testing to be performed in accordance with ASTM E477 and ADC Test Code FD 72-RI by ETL

	<i>Sound Power Levels, dB re. 10⁻¹² Watts, at Octave Band Center Frequency, Hz</i>						
	<i>63</i>	<i>125</i>	<i>250</i>	<i>500</i>	<i>1000</i>	<i>2000</i>	<i>4000</i>
<i>Insertion Loss</i>	<i>5.7</i>	<i>14</i>	<i>13</i>	<i>15</i>	<i>16</i>	<i>18</i>	<i>16</i>

- 4. Duct Fabric:
 - a. Spunbond Nylon fabric. Fabric to be mechanically locked to the duct helix without the use of adhesives
- 5. Duct Helix
 - a. Corrosive resistant galvanized steel. Helix is to be mechanically formed to attach the duct fabric without the use of adhesives.

6. Vapor Barrier
 - a. Fire retardant, reinforced aluminum.
 - b. (.05) perm A.S.T.M. E96, Procedure A
7. Insulation
 - a. Factory insulation jacket, factory wrapped. R8 minimum.
8. Flexmaster Type 6M or equal.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
- I. Round Duct Supports:
 1. Minimum 2" wide 20-gauge galvanized metal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades.
- B. Ductwork Installation – General:
 1. Install ducts in accordance with manufacturer's written installation instructions.

2. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
3. Construct with gages, joints, bracing, reinforcing, and other details per latest IMC, ASHRAE, SMACNA and NFPA, unless specified otherwise.
 - a. Comply with most stringent.
 - b. Provide ducts with IMC gages or thicker when traversing rated corridors.
 - c. Combustion air ducts: Minimum 24 gage.
4. Construct of galvanized sheet metal, except where otherwise indicated herein or on Drawings.
5. Provide for duct rigidity by either of these methods:
 - a. Beading at 12 inches on center, maximum.
 - b. Cross-break outward in ducts having positive internal pressure.
 - c. Cross-break inward in ducts having negative internal pressure.
 - 1) Exception: All ducts exposed to rain shall outward cross-break on top of the duct.
6. Duct dimensions indicated are outside duct dimensions (OD) unless indicated on the Drawings as inside dimension (ID or net, clear dimension).
7. Alter duct sizes on basis of equal friction where required to facilitate installation. Reflect changes in shop drawings for review by Architect.
8. At duct penetrations of walls, floors and ceilings where exposed to occupant view, provide sheet metal angle type escutcheons with no sharp corners or edges.
 - a. Clearance from duct to opening shall not exceed 2 inches.
 - b. Escutcheons shall overlap wall, floor, or ceiling surface by ½ inch minimum.
9. Frame, trim, caulk and seal all duct penetrations through acoustical walls and partitions.
10. Tapers:
 - a. Pitch sides of duct in diverging or converging airflow maximum of 1 to 4 taper.
 - b. Abrupt, bushing type fitting not allowed.
11. Duct Openings:
 - a. Provide openings where required to accommodate thermometers, smoke detectors, controllers, and the like. Insert through airtight rubber grommets.
 - b. Where openings are provided in insulated ductwork for insertion of instruments, install insulation material inside metal ring for use as plug.
 - c. At fire dampers allow adequate length of duct to install access door.
12. Avoid penetration of ducts; provide airtight seal at unavoidable penetrations of hanger rods.
13. No exposed sharp metal allowed.
 - a. All exposed pins, screws and sharp objects shall be covered with hardening silicon.
 - b. All exposed sheet metal edges shall be hemmed with exposed corners rounded smooth.
 - c. Remove all sheet metal fishhooks.
14. Install lining in ducts and plenums as specified in Section 230713 – Duct Insulation.

15. Flexible Connections:

- a. Coated glass fabric.
- b. For indoor or outdoor use.
- c. Use diaphragm type at plug fan inlets.
- d. Install at connections to fans and air handling units and as indicated on Drawings.
- e. 2-inch slack in fabric; install to allow minimum movement of 1 inch in both tension and compression.
- f. Protect from direct solar and rain exposure with sheet metal shroud where outdoors.

C. Elbows and Splits:

1. Use radius elbows in rectangular ducts unless otherwise indicated on the Drawings: Centerline radius dimension shall not be less than 1-1/2 duct width.
2. Where space does not permit duct radius specified above, install short radius splitter vanes per SMACNA HVAC Duct Construction Standard.
 - a. Number of vanes determined by ratio of inner radius (R) to duct width in plane of radius (W).
 - b. One vane: Radius to width ratio above 0.3.
 - c. Two vanes: Radius to width ratio between 0.1 to 0.3
 - d. Three vanes: Radius to width ratio 0.1 and smaller.
3. Use square turns with turning vanes in rectangular ductwork, unless otherwise indicated on the Drawings, at following locations.
 - a. Use only where full radius elbow cannot fit.
 - b. Use only in ducts with 2000 fpm or less design velocity.
 - c. In high and medium pressure ductwork spot weld turning vane to duct.

D. Rectangular Duct Joints:

1. Transverse Joints:
 - a. In medium pressure ductwork shall be Fabriduct TDC or Ductmate or equal.
 - b. In low pressure ductwork shall be Fabriduct TDC or equal except, that ducts under 19 inches longest side may be slip & drive (S&D)
2. Longitudinal seams shall be Pittsburgh. Snap lock not allowed.

E. Plenum walls, blank-offs, and casings:

1. Construct per SMACNA HVAC Duct Construction Standard, Casings and Plenums.
2. Static pressure class:
 - a. Upstream of fan: -2 inches.
 - b. Downstream of fan: fan static pressure or greater.
3. Seal all joints, edges, and penetrations as per HVAC ducts as specified herein.

F. Round and oval ductwork:

1. Joints between ducts:
 - a. Made with beaded sleeve joints as scheduled.

- b. Duct sealer applied to male end.
- c. Mechanically fastened with sheet metal screws or pop rivets.
- d. Over joint and screw or rivet heads, apply coating of duct sealer.

- 1) Duct where exposed to occupant view: Sealant shall be within joint only and not visible.

2. Joints, duct and fitting:

- a. Slip projecting collar of fittings into duct: Per SMACNA HVAC Duct Construction Standard.
- b. Apply duct sealer: Seal and tape as specified above.
- c. Mechanically fasten: Fastening schedule: Per SMACNA HVAC Duct Construction Standard.

3. Branch take-offs:

- a. Medium pressure: 45 degrees (fittings).
- b. Low pressure: straight 90 degrees (fittings).

4. Horizontal supports:

- a. One or two-piece clamp band strap.
- b. Minimum: one per section.
- c. Support fittings as required to prevent sagging.

5. Vertical Supports: one of the following:

- a. Clamp bands with extended ends supported by floor.
- b. Clamp bands with knee bracing.
- c. Pedestal at base of vertical.

G. Flexible ductwork:

1. Not allowed for:

- a. Return, exhaust, or outdoor air ducts.
- b. Product conveying systems such as kitchen exhaust and laboratory exhaust.
- c. Dryer exhaust (other than final exposed connection at dryer).
- d. Medium and high pressure, ducts.

2. Continuous, single pieces:

3. Length:

- a. Low pressure:
 - 1) Maximum 5 feet, except where longer lengths are indicated on drawings. Where longer lengths are shown, the last 3 feet to 5 feet shall be wire flex duct and remaining ductwork shall be aluminum flex duct.
 - 2) Minimum length: 3 feet.

4. End connections:

- a. Connect to duct collars, terminal unit connections and round air outlets per manufacturer's instructions.

- b. Secure with strap clamps specified above.
5. Installations:
- a. Support adequately to avoid excessive droop.
 - b. Minimum inside bending radius not less than one duct diameter.
 - c. Install as straight as possible except as shown on drawings for sound attenuation.
 - d. Cut ducts to lengths required rather than create bends to take up excess lengths except as shown on drawings for sound attenuation.

H. Grille connections:

1. Provide at entry to diffuser collar either.
- a. Straight duct for 1 duct diameters or greater.
 - b. Full radius elbow.
 - c. Side inlet plenum.
 - 1) Height: 4 inches minimum taller than top of grille to provide room for uniform airflow to grille.
 - 2) Width/length: 2 inches wider than duct or round diffuser collar, whichever is larger.
 - 3) Internal surfaces lined with minimum 1/2-inch-thick Type AL duct liner as specified under Section 230713 – Duct Insulation.
 - 4) At contractor's option, where plenum is required at round neck diffuser, square neck diffuser with length and width equal to diffuser diameter may be substituted.
 - d. Thermaflex FlexFlow Elbow or equal.
2. Connections at grilles shall be insulated to the extent the duct is insulated including the final register box.
3. Seal connections at grilles per seal class of upstream ductwork.

I. Sound-rated duct packing:

- 1. Wherever possible avoid duct penetrations through sound-rated walls, floors and ceilings.
- 2. Provide packing for unavoidable duct penetrations.

3.2 DUCT SEALING

A. Ducts not exposed to weather: Seal using one of the following:

- 1. Duct sealer compound.
- 2. Gasketed TDC or Duct-Mate.
- 3. Two-Part Hard-Setting Joint Tape.
- 4. Flexible duct:
 - a. Secure with straps or clamps as specified herein.
 - b. Supplement with duct tape, both inner and outer liner.
- 5. Indoor duct where exposed to occupant view: Sealant shall be within joint only and not visible.

6. Fire and fire/smoke dampers: Sealant shall be listed as approved on manufacturer's UL installation sheet.
7. Continuously welded ducts: Additional sealing not required.

- B. Seal punched holes and corner cracks.
- C. Seal all factory fabricated ducts, including transverse joints on gored elbows.
- D. Seal end caps.
- E. After installation and testing reseal joints found to be leaking at no additional cost to the Owner.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor, and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.6 PROTECTION

- A. Adhere to SMACNA Duct Cleanliness for New Construction Guidelines for Intermediate Level Duct Cleanliness unless more stringent requirements are indicated herein.
- B. Storage: Porous materials, such as lined and flexible duct, shall be stored where they will not be exposed to rain or other moisture sources.
- C. Temporary closure: Provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris at the following conditions:
 - 1. Exposed ends of unlined installed ducts at the end of each day.
 - 2. Exposed ends of lined ducts or plenums whether in storage or installed.
- D. Duct cleaning:
 - 1. Using the connected fan(s) force air at high velocity through duct to remove accumulated dust.
 - 2. Protect equipment and spaces, which may be harmed by excessive dirt with filters, or bypass during cleaning.
 - 3. In areas, which must be kept dust free, seal all outlets duct tight. When closures are removed avoid spilling dust in room.

3.7 INSPECTION

- A. Verify that adequate clearance between ducts and adjacent walls or equipment is available to permit proper sealing, maintenance, and repairs.

3.8 PRE-OPERATING CHECKS

- A. Before operating the duct systems: Set all manual dampers in full open position.

3.9 TESTING AND ADJUSTING

- A. After starting the duct systems: Check for noise and leakage. Repair as required at no additional cost to the Owner.
- B. See Section 230593 – Testing, Adjusting, and Balancing: Coordination with Balance Agency:
 - 1. Provide services of a sheet metal installer familiar with the system ductwork to provide assistance to the balancing agency during the initial phases of air balancing in locating all sheet metal dampers.
 - 2. Install missing dampers.

END OF SECTION 233113

SECTION 233115 - OUTDOOR DUCT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Outdoor Duct Systems
 - 2. Ducts Exposed to Weather

1.3 REFERENCE STANDARDS

- A. International Mechanical Code, current edition
- B. American Standards: ASTM C 518 2004
- C. Standard Test Methods for Water Vapor Transmission of Materials: ASTM E 84-08a
- D. Standard Test Method for Surface Burning Characteristics of Building Materials: UL 723
- E. Test for Surface Burning Characteristics of Building Materials: NFPA 90A
- F. Standard for the Installation of Air Conditioning and Ventilating Systems: NFPA 90B
- G. Standard for the Installation of Warm Air Heating and Air-Conditioning Systems: UL/ULC 181
- H. SMACNA HVAC Phenolic Duct Construction Standards

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements.
 - 1. Entire ductwork system, including materials and installation, installed in accordance with NFPA 90A.

1.5 SUBMITTALS

- A. See Section 230010 Mechanical General Provisions.
- B. Submit product data, O&M data, and samples and show item on shop and coordination drawings according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

C. Product Data: For each type of the following products:

1. Sealants and gaskets.

D. Submit electronic layout and shop fabrications drawings for approval.

1. Isometric view of duct assembly with duct sections indicated on drawing to match part number tagging on delivered duct sections.
2. Fabrication and assembly instructions.
3. Details for connecting to other components (i.e. curbs, rooftop units, mechanical room walls, etc.)
4. Duct layout indicating sizes and pressure classes.
5. Elevations of top and bottom of ducts.
6. Dimensions of main duct runs from building grid lines.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels

Item	Product Data	O&M Manual	Samples	Shop Drawing
Outdoor Ducts and Plenums	R			R
Sealants and gaskets	R			
Duct pressure testing reports		R		

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Outdoor Ducts:
 1. Ducts and Cleats.
 2. Therma duct.
 3. Polyguard
 4. Or approved equal.

2.2 MATERIALS

- A. Ducts and Cleats Pro-R: Pre-assembled: Exterior ductwork is to be a pre-insulated (R-8.1), pre-fabricated, duct system. Duct to be 2 layers, 1-1/2" panel. The panels used in the fabrication of the ductwork system shall be closed cell phenolic foam with autohesively bonded aluminum foil. Outdoor TDC flange covers. Color to be selected by Professional from full range color chart.
- B. Thermoduct:

1. Exterior ductwork is to be a pre-insulated, pre-fabricated, duct system. Duct to be 2 layers, 1-3/16" panel.
2. The panels used in the fabrication of the ductwork system shall be closed cell phenolic foam.
3. Duct system shall consist of 1000 micron titanium infused vinyl cladding.
4. Duct system shall use no tapes or adhesives to assemble pieces. Joints to be connected with a gasketed 4 bolt flanging system and covered with manufacturers joint covers.
5. Color to be selected by Professional from full range color chart.

C. Polyguard

1. Outdoor Duct

- a. Galvanized steel G-90, 304 stainless steel, or aluminum.
- b. Make ducts subject to rain watertight.
- c. Construct as follows to assure water run-off.
 - 1) Arrange standing seams to not act as dams.
 - 2) Longitudinal seams at bottom of duct.
 - 3) Construct all ducts subject to rain watertight and to insure water runoff by one or more of following techniques.
 - a) Slope entire top of duct down toward side.
 - b) Vertical struts within duct to bow top panels of duct into convex shape.
- d. TDC or Duct-Mate joints: Utilize interior joint gasket material plus a bead of butyl rubber sealant at the joint and continuous metal clip or cleat over the top of all four joints (top bottom and sides).
- e. Continuously welded ducts: Additional sealing not required.
- f. Other joints: Apply two part hard-setting joint tape to:
 - 1) Longitudinal joints.
 - 2) Horizontal joints.
 - 3) Transverse joints.
 - 4) TDC or Duct-Mate joints.
 - 5) Duct penetrations.
 - 6) Screws through duct.
 - 7) Gores of elbows

2. Insulation

- a. Duct Board with Vapor Barrier
 - 1) Insulation: ASTM C612; rigid, noncombustible board.
 - a) 'K' ('Ksi') value: ASTM C518, 0.23 at 75 degrees Fahrenheit.
 - b) Maximum service temperature: 350 degrees Fahrenheit.
 - c) Maximum moisture absorption: 0.20 percent by volume.
- b. Vapor Barrier Jacket - factory installed (FSK).
 - 1) Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2) Moisture vapor transmission: ASTM E96 Procedure E; 0.02 perm.
 - 3) Secure with pressure sensitive tape.

- c. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based, adhesive.
- d. Installed conductance: 0.23 BTU-inch/hr./square foot/degree Fahrenheit.
- e. 1-inch Thickness, 3.0 pounds per cubic foot.
- f. Factory applied jacket.

- 1) Foil-scrim-kraft laminate.
 - a) Aluminum foil facing.
 - b) Glass scrim reinforcing.

3. Self-Adhesive, Field-Applied, Outdoor Jackets

- a. Manufacturers:
 - 1) Alumaguard, Alumaguard All-Weather, Alumaguard Lite
 - 2) 3M.
 - 3) MFM Building Products Corp.
- b. General Requirements for Self-Adhesive Outdoor Jacket: Laminated vapor barrier and waterproofing membrane with perm rating of 0.00 perm, when tested according to ASTM E 96/E 96M, for installation over either fiberglass or foam board insulation located above ground outdoors; consists of a foil polymer laminated film with a coating of rubberized bituminous compound or acrylic adhesive that allows membrane to self-adhere to the substrate.
- c. Alumaguard: Composite membrane consisting of a multi-ply embossed UV resistant aluminum foil/polymer laminate to which is applied a layer of rubberized asphalt.
 - 1) Alumaguard Membrane Thickness: 56-mils
 - 2) Alumaguard Cool Wrap Membrane Thickness: 59-mils.
 - a) Solar Reflectance, CRRC Initial Rating: 0.86.
 - b) Solar Reflectance, CRRC 3-Year Rating: 0.77.
 - c) Thermal Emittance, CRRC Initial Rating: 0.82.
 - d) Thermal Emittance, CRRC 3-Year Rating: 0.86
- d. Alumaguard Lite® is a multi-ply aluminum foil/polymer composite film coated with an aggressive, low-temperature acrylic adhesive.
 - 1) Smooth Silver Thickness: 7-mils.
 - 2) Stucco Embossed Silver Thickness: 9-mils
 - 3) White Matte Cool Wrap Finish Thickness: 9-mils
 - a) Solar Reflectance, CRRC Initial Rating: 0.86.
 - b) Solar Reflectance, CRRC 3-Year Rating: 0.77.
 - c) Thermal Emittance, CRRC Initial Rating: 0.82.
 - d) Thermal Emittance, CRRC 3-Year Rating: 0.86.
 - 4) Alumaguard Lite White Thickness: 9-mils
- e. Alumaguard All-Weather: Hybrid product combining the UV-resistant aluminum foil/polymer laminate and rubberized asphalt used in the Alumaguard product, with a metalized film coated with low temperature acrylic adhesive.

- 1) Alumaguard All-Weather Membrane Thickness: 35-mil
- 2) Alumaguard All-Weather with Cool Wrap Coating Thickness: 38-mils
 - a) Solar Reflectance, CRRC Initial Rating: 0.86.
 - b) Solar Reflectance, CRRC 3-Year Rating: 0.77.
 - c) Thermal Emittance, CRRC Initial Rating: 0.82.
 - d) Thermal Emittance, CRRC 3-Year Rating: 0.86

D. Double Wall Round Ducts and Fittings

1. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of aluminum/galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Ducts to have a solid inner liner, a 1-inch layer of fiberglass insulation (1-1/2 pounds per cubic foot density) and an outer pressure cell.
2. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated. Outer duct to be aluminum.
3. Inner Duct: Minimum 0.028-inch solid wall galvanized sheet steel.
4. Duct Joints:
 - a. Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket. Seal all connections water tight.
5. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
6. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
7. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:
 - a. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - b. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
 - c. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - d. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - e. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - f. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 - g. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
 - h. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
8. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - a. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

- b. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
- c. Coat insulation with antimicrobial coating.
- d. Cover insulation with polyester film complying with UL 181, Class 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades.
- B. All duct to be installed in strict accordance with manufacturer's installation instructions and/or guidelines.

3.2 INSTALLATION OF DUCT SYSTEMS

- A. Supports
 - 1. It shall be the responsibility of the contractor to ensure that the ductwork system is properly and adequately supported. A number of support systems are approved for use by AQC Industries. It shall be the responsibility of the contractor to ensure that the chosen method of support is compatible with ductwork fabricated from the Pal Phenolic Duct System and AQC Industries. Submit all supports for Duct
 - 2. Supports on straight runs of the QDuct ductwork System shall be positioned at center's not exceeding 10 ft for ductwork sections fabricated in 10 ft lengths, and 13 ft for ductwork sections fabricated in 13 ft lengths.
 - 3. Additionally, ductwork shall be supported at changes of direction, at branch duct connections, tee fittings and etc.
 - 4. All ductwork accessories such as dampers shall be independently supported.
- B. Hangers and Supports
 - 1. Hanger Materials: SMACNA Approved duct supports shall be utilized in accordance with SMACNA Standards for Phenolic Duct.
 - 2. Penetration into the QDuct system duct is not permitted.
 - 3. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 4. Exterior Duct Supports:
 - a. To meet all SMACNA and ASHRA requirements.
 - b. Supports to be installed on the outside finished QDuct System
 - c. Supports to be manufactured by PHP System/Design, Miro or Approved Equal.

3.3 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Ductwork exposed to occupant view shall be run straight and true, in line with building elements. No sagging or out-of-true straight runs shall be acceptable. Sidewall taps and duct joints shall be clean and free of visual blemishes and all sealant shall be internal to joint and not visible. Ducts shall have no external markings or tags. All duct beads shall be parallel.

- C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- F. Repair or replace damaged sections and finished work that does not comply with these requirements.
- G. Hanger and Support Installation
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
 - 2. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - a. Where practical, install concrete inserts before placing concrete.
 - b. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - c. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - d. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 3. 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.
 - 4. Hangers Exposed to View: Threaded rod and angle or channel supports.
 - 5. 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 maximum intervals of 16 feet.
 - 6. 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.

3.4 DUCT PRESSURE TESTING

- A. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Supply, Return, Exhaust, and Outdoor Air Ducts: Test 100% of installed duct sections.
 - b. Field installed plenums. Test 100% of all field installed plenums.

3. Allow 24 hours for sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions
4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advanced notice for testing.

B. General:

1. Pretesting shall be conducted prior to conducting test in presence of TAB Agency and Architect. Once all required ductwork has passed the pretest duct pressure test, the TAB Agency and Architect shall be notified to visit the site for witness testing.
2. Use portable high-pressure blower and necessary instruments to indicate amount of leakage.
3. Conduct tests as prescribed in SMACNA HVAC Air Duct Leakage Test Manual and make test before duct sections are concealed.
4. Procedure:
 - a. Seal openings in ducts and plenums to be tested.
 - b. Connect test apparatus to test section using flexible duct connection or hose.
 - c. Close damper on blower suction side, to prevent excessive buildup of pressure.
 - d. Start blower and gradually open damper on suction side of blower.
 - e. Build up pressure in test section equal to static pressure class.
 - f. Noise generated from duct leakage not acceptable. Seal as required.
 - g. Determine amount of air leakage by makeup air flow measurements:
 - 1) Maximum permitted leakage for HVAC ductwork shall be:

$$CFM_{max} = \left(\frac{A}{100} \right) C_L P^{0.65}$$

Where,

- CFM_{max} = The maximum permitted leakage, cubic feet per minute (cfm).
 A= Surface area of the tested duct sections, square feet.
 C_L= Duct leakage class, cfm/100 square feet at 1 inch water column.
 = 6 for rectangular sheet metal, rectangular fibrous ducts, and round flexible ducts
 = 3 for round/flat oval sheet metal or fibrous glass ducts
 P= Test pressure which shall be equal to the design duct pressure class rating, inches water column.

- 2) Allowable leakage can also be calculated as 1 percent of the design operating air volume for the entire system. If this method is used, the total system leakage must first be determined and then compared with the 1 percent (of system volume flow) allowable leakage. Acceptance is indicated if the actual measured leakage of the entire system is less than the calculated allowable leakage.
- 3) If leakage exceeds permitted limit, repair leaks and retest duct sections at no additional cost to the Owner until permitted leakage limits are obtained.

5. Visually mark tested sections with certification sticker and initials of field test inspector.

- C. Documentation:
 - 1. Submit certification of test results of compliance to Architect.
 - 2. Include certified test results showing compliance per Section 230010 – Mechanical General Provisions.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 PROTECTION

- A. Adhere to SMACNA Duct Cleanliness for New Construction Guidelines for Intermediate Level Duct Cleanliness unless more stringent requirements are indicated herein.
- B. Storage: Porous materials, such as lined and flexible duct, shall be stored where they will not be exposed to rain or other moisture sources.
- C. Temporary closure: Provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris at the following conditions:
 - 1. Exposed ends of unlined installed ducts at the end of each day.
 - 2. Exposed ends of lined ducts or plenums whether in storage or installed.
- D. Duct cleaning:
 - 1. Using the connected fan(s) force air at high velocity through duct to remove accumulated dust.
 - 2. Protect equipment and spaces, which may be harmed by excessive dirt with filters, or bypass during cleaning.
 - 3. In areas, which must be kept dust free, seal all outlets duct tight. When closures are removed avoid spilling dust in room.

3.6 INSPECTION

- A. Verify that adequate clearance between ducts and adjacent walls or equipment is available to permit proper sealing, maintenance and repairs.

3.7 PRE-OPERATING CHECKS

- A. Before operating the duct systems: Set all manual dampers in full open position.

3.8 TESTING AND ADJUSTING

- A. After starting the duct systems: Check for noise and leakage. Repair as required at no additional cost to the Owner.
- B. See Section 230593 – Testing, Adjusting, and Balancing: Coordination with Balance Agency:

1. Provide services of a sheet metal installer familiar with the system ductwork to provide assistance to the balancing agency during the initial phases of air balancing in locating all sheet metal dampers.
2. Install missing dampers.

END OF SECTION 233115

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following: All air outlets, inlets, grilles, registers and diffusers except where integral with manufactured piece of equipment

1.3 REFERENCE STANDARDS

- A. ARI Standard 650 – Air Outlets and Inlets.
- B. ASHRAE Standard 70 – Methods of Testing for Rating the Airflow Performance of Outlets and Inlets.
- C. AMCA Standard 500 – Laboratory Methods of Testing dampers for Rating.
- D. NFPA Standard 90A – Installation of Air Conditioning and Ventilating Systems.
- E. NFPA 90B – Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

1.4 QUALITY ASSURANCE

- A. Comply with ARI Standard 650, ASHRAE Standard 70, AMCA Standard 500, NFPA Standard 90A, and NFPA Standard 90B.
- B. Provide outlets and inlets that have, as minimum, throw and noise criteria ratings for each size device as listed in manufacturer's current data, rated as required by the above standards.

1.5 SUBMITTALS

- A. See Section 230010 – Mechanical General Provisions
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Grilles, registers, and diffusers	R			R
Accessories	R			

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
1. Titus.
 2. Price.
 3. Metal Aire.
 4. Nailor.
 5. Or equal.

2.2 AIR DISTRIBUTION DEVICES

- A. Manufacturer shall examine and approve of application of each outlet.
- B. Noise level at design capacities: no larger than diffuser selection indicated on the drawings.
- C. Material:
1. All grilles are to be of steel construction unless otherwise indicated on schedules.
- D. Volume dampers:
1. Do not provide dampers built into grille or directly attached to the grille unless specifically called out on drawings.
 2. Opposed blade volume damper key-operated adjustable from face of diffuser on register except as noted.
- E. Diffuser frame:
1. Frame type shall be coordinated with ceiling type. Refer to architectural reflected ceiling drawings.
 - a. At plaster or drywall ceilings:
 - 1) Lay-in diffuser with drywall frame (Titus TRM to match diffuser material). Drywall frame to match diffuser color.
 2. No visible screw allowed on diffusers or frames, unless otherwise indicated on the Drawings.
 3. Linear and bar diffusers shown as one collinear piece on plans shall be constructed as one piece within manufacturing limitations and to appear as one section if manufacturing

limitations require multiple pieces. Provide with Border Type shown on plans. Coordinate exact border type with design professional before ordering.

- F. Color:
 - 1. Face and frame: Factory-baked #26 white enamel unless otherwise indicated on the Drawings.
 - 2. Internal parts of grille visible from occupied space, including all parts behind perforated face diffusers and visible parts of plenums: flat black.
- G. Provide square to round adapters where required.
- H. Provide one-, two-, three- or four-way discharge patterns as indicated on plans.
- I. See mechanical schedules for type and sizes.

2.3 SCREENED OPENINGS

- A. Mesh:
 - 1. 3/4 in. square pattern.
 - 2. No. 16 galvanized wire.
 - 3. Interwoven.
 - 4. Welded or secured to frame.
- B. Frames:
 - 1. 1 inch by 1 inch by 1/8 inch galvanized steel angles.
 - 2. Continuous around perimeter of screen (welded at corners).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades.
- B. Install air outlets and inlets in accordance with manufacturer's written installation instructions and Section 233113 – Metal Ducts.
- C. Return and exhaust registers: Install with blades oriented to prevent sight through outlets.
- D. Grille backs or plenums visible through grilles painted flat black.
- E. Transfer grilles.
 - 1. See indications on the Drawings.
 - 2. Wall installations, unless otherwise indicated, provide two grilles.
 - a. One on each side of wall, except where open to return air plenum.
 - b. Connecting sheet metal collar with 18 inch elevation offset for sound and light attenuation.

- F. Provide duct screens at termination ducts as indicated on the Drawings.

3.2 MOUNTING AND ALIGNMENT

- A. All air outlets and inlets shall be secured to building.
 - 1. Ceiling grilles shall be secured to prevent falling from ceiling during construction or service with minimum of two 16-gauge ceiling wires, two 22-gauge by 1-inch galvanized sheet metal strap or two #10 sheet metal screws.
 - 2. Comply with IBC.
- B. Mount directional grilles as indicated on the Drawings.
- C. Adjust grille throw patterns.
 - 1. As indicated on the Drawings.
 - 2. For double-deflection grilles, adjust rear blades horizontal and front blades in 45-degree pattern at each end gradually rotating to be almost straight at blades in center of grille.
 - 3. Adjust grille throw patterns prior to test and balance. See Section 230593 – Testing, Adjusting, and Balancing.

3.3 INSPECTION

- A. Verify mounting, direction and adjustments are installed as indicated on the Drawings.

3.4 TESTING AND ADJUSTING

- A. See Section 230593 – Testing, Adjusting, and Balancing.

END OF SECTION 233700

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS (WITH ERV)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes dedicated outdoor air units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 SUBMITTALS

- A. See Section 23 00 10 Mechanical General Provisions.
- B. Submit product data, O&M data, and samples and show item on shop and coordination drawings (where shop and coordination drawings are required) according to the following table.
 - 1. "R" means required.
 - 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Samples	Shop Drawing
Air handling units	R	R		R
Coils, performance data	R	R		R
Fans, performance data	R			
Acoustical performance data	R			
Motors	R	R		
Dampers and actuators	R	R		
Filters	R			
Factory installed controls (controllers, control devices, etc.)	R	R		R
Accessories	R	R		R
Coordination drawings				R

- C. Additional submittal requirements.
 - 1. List of exceptions to the specifications including section number and a detailed description of alternative materials and methods. If there are no exceptions, so state in precise language.
 - 2. List of proposed manufacturers for fans, filters, coils, motors, drives, dampers and other components.

3. Complete graph of fan curves (not just curve for design conditions) indicating efficiency, BHP, and RPM.
4. Sound power levels per ARI 260 by octave bands; radiated and at inlet and discharge.
5. Coil performance and flow rates.
6. Filter and filter frame product data.
7. Wiring diagram.
8. Control panel location, including elevation indicating height above the ground.
9. Internal static pressure drop with filters clean and dirty.
10. Casing materials of construction and methods of assembly.
11. Construction details including panel sealing, thermal break, door seal and hardware, shipping split and field treatment of panel penetration (sleeve) details.
12. The number of shipping sections requiring field reassembly.
13. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show service clearance requirements, and support locations, type of support, and weight on each support. Indicate and certify field measurements.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: Two sets for each air-handling unit.
 2. Gaskets: Two sets for each access door.
 3. Fan Belts: One set for each air-handling unit fan.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following codes:
- B. UL Standard: Provide units complying with UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
- C. UL and NEMA Compliance: Provide ancillary electrical components required as part of energy recovery units that are listed and labeled by UL and that comply with applicable NEMA standards.
- D. Comply with NFPA 70 for components and installation.
- E. DX and water coils shall be AHRI Certified per standard 410-2001.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate size and location of equipment supports, housekeeping pad, and wall penetrations.
- B. Coordinate construction sequencing of associated plumbing and electrical systems.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Heat Exchangers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
 1. Daikin.
 2. Greenheck
 3. Aeon.
 4. Or equal.

2.2 DEDICATED OUTDOOR AIR UNITS

- A. Surfaces in contact with the airstream shall comply with requirements of ASHRAE Standard 62.1-2010.
- B. Unit Casing and Frames.
 1. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0 and shall be 2-part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.
 2. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long-term durability. Finished panel surfaces to withstand a minimum 1000-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.
 3. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless-steel hinges and shall be secured by a latch system.
- C. Energy Recovery Wheel.
 1. Wheel shall be of the enthalpy type for both sensible and latent heat recovery and be designed to insure laminar flow.
 2. Desiccant shall be silica gel.
 3. Wheel shall be constructed of light weight polymer media.
 4. Silica gel desiccant shall be permanently bonded to wheel media.
 5. Wheel performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.
 6. The exhaust air fan shall be a direct drive SWSI plenum fan. The unit controller shall control the exhaust fan to maintain building pressure. A VFD shall be provided for the exhaust fan motor, or the exhaust fan motor shall be an ECM motor. The rooftop unit shall have single point electrical power connection and shall be ETL listed.
 7. The control of the energy recovery wheel shall be an integral part of the DDC controller. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures

shall be displayed at the units DDC controller LCD display. All of these temperatures shall be made available through the BACnet interface.

8. The rooftop unit DDC controller shall provide frost control for the energy recovery wheel. When a frost condition is encountered the unit controller shall stop the wheel. When in the frost control mode, the wheel shall be jogged periodically and not be allowed to stay in the stationary position.

D. Exhaust Fan

1. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim.
2. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
3. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

E. Supply Fan

1. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim.
2. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.
3. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
4. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range

F. Dampers.

1. Motorized outdoor air intake and exhaust air dampers.
2. Low leakage type, factory installed. End/jamb seals and insulated blades.
3. Meet ASHRAE Standard 90.1-2010 damper leakage requirements.

G. Filters.

1. 2" MERV 8 disposable filters.

H. Electrical.

1. All internal electrical components shall be prewired for single point power connection.
2. All electrical components shall be UL listed, approved or classified where applicable and wired in compliance with the National Electrical Code.
3. Single-point high voltage connection.

I. Direct Expansion (DX) Cooling/Heating Coil.

1. Factory tested and rated in accordance with AHRI 410.
2. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.
3. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.
4. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.
5. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
6. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

J. Hot Gas Reheat Coil.

1. Factory tested and rated in accordance with AHRI 410.
2. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser
3. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.
4. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.
5. Each coil shall be factory leak tested with high-pressure air under water.

K. Natural Gas Furnace.

1. Indirect gas-fired furnace.
2. The rooftop unit shall include a natural gas heating section. The gas furnace design shall be one natural gas fired heating module factory installed downstream of the supply air fan in the heat section. The heating module shall be a tubular design with in-shot gas burners.
3. The module shall be complete with furnace controller and control valve capable of 10:1 modulating operation.
4. The heat exchanger tubes shall be constructed of stainless steel.
5. The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.
6. Each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.

7. The factory-installed DDC unit control system shall control the gas heat module. Field installed heating modules shall require a field ETL certification. The manufacturer's rooftop unit ETL certification shall cover the complete unit including the gas heating modules.

L. Condensing Section

1. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.
2. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 0~120°F. Mechanical cooling shall be provided to 25° F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.
3. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.
4. The unit shall have scroll compressors. One of the compressors shall be an inverter/digital compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature.
5. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors.
6. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.
7. Each circuit shall be dehydrated, and factory charged with R-410A Refrigerant and oil.

M. Unit Controls.

1. Provide remote controller with LCD touchscreen.
2. Configure unit for space temperature and humidity control.
3. Configure unit for building pressure control.
4. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors.
5. DDC controller with integral LCD screen and built-in keypad.
6. DDC controller communication protocol: BACnet MSTP.
7. Variable frequency drives/ECM Motors (supply and exhaust fans, energy recovery wheel).
8. Unit shall be furnished with the following sensors, also See Drawings for additional controls.
 - a. Space temperature sensor.
 - b. Space humidity sensor.
 - c. Building static pressure sensor.
 - d. Dirty filter sensors (supply and exhaust).
 - e. CO2 sensor (duct mounted).
 - f. Temperature sensors.
 - 1) Outdoor air entering wheel.
 - 2) Outdoor air leaving wheel.
 - 3) Outdoor air leaving cooling coil.
 - 4) Outdoor air supply air.
 - 5) Exhaust air entering wheel.

- 6) Exhaust air leaving wheel.
- g. Pressure sensors.
 - 1) Outdoor air wheel pressure.
 - 2) Outdoor air filter pressure.
 - 3) Exhaust air wheel pressure.
 - 4) Exhaust air filter pressure.
- h. Current sensors.
 - 1) Supply fan.
 - 2) Exhaust fan.
- i. Energy recovery wheel rotation sensor.
- j. Phase monitor.
- k. Defrost control.

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 piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Equipment Mounting:
 - 1. Install air units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
- C. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- D. Install 3000-psi, compressive-strength (28-day) concrete base inside roof curb, 4 inches thick. Concrete and reinforcement are specified with concrete.
- E. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- F. Install separate devices furnished by manufacturer and not factory installed.

- G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- H. Install drainpipes from unit drain pans to sanitary or storm drain.
 - 1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B 88, Type L, with soldered joints.
 - 2. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

- A. Where installing piping adjacent to units, allow space for service and maintenance.
- B. Refrigerant piping: Refrigerant piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping."
- C. Gas Piping Connections:
 - 1. Comply with requirements in Section 231123 "Facility Natural-Gas Piping."
 - 2. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
 - 3. Install AGA-approved flexible connectors.
- D. Duct Connections:
 - 1. Comply with requirements in Section 233113 "Metal Ducts."
 - 2. Drawings indicate the general arrangement of ducts.
 - 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."
- E. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
 - 1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect and clean exposed finishes. Remove dirt and construction debris and repair damaged finishes.

3.5 STARTUP SERVICE

- A. Startup to be by a manufacturer/factory employee (factory authorized startup is not acceptable). Design professional is to be present during startup with manufacturer employee present. Provide 48 hours' notice before startup at a minimum to allow design professional to be present.
- B. Provide startup checklist in submittal and provide during startup. Items below are a minimum for startup.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Inspect units for visible damage to furnace combustion chamber.

3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
 - a. Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.
 - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-limit heat exchanger.
 - b. Alarms.
5. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
 - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.
 - d. Condenser coil leaving-air dry-bulb temperature.
6. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
7. Inspect casing insulation for integrity, moisture content, and adhesion.
8. Verify that clearances have been provided for servicing.
9. Verify that controls are connected and operable.
10. Verify that filters are installed.
11. Clean coils and inspect for construction debris.
12. Clean furnace flue and inspect for construction debris.
13. Inspect operation of power vents.
14. Purge gas line.
15. Inspect and adjust vibration isolators.
16. Verify bearing lubrication.
17. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
18. Adjust fan belts to proper alignment and tension.
19. Start unit.
20. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
21. Operate unit for run-in period.
22. Calibrate controls.
23. Adjust and inspect high-temperature limits.
24. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
25. Verify operational sequence of controls.
26. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Outdoor-air flow.

- C. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- D. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- E. Prepare written report of the results of startup services.

3.6 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. After starting units: Check for objectionable noise or vibration. Correct as needed at no additional cost to the Owner.
- D. Balancing: See Section 230593 "Testing, Adjusting and Balancing for HVAC."
- E. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433

DIVISION 26

ELECTRICAL

**DIVISION 26
ELECTRICAL SYSTEMS**

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A circular professional seal for John M. Wynne, a Registered Professional Engineer in the State of Mississippi. The seal contains the text "JOHN M. WYNNE", "REGISTERED PROFESSIONAL ENGINEER", and "#11869". A handwritten signature is written across the seal. Below the seal is the date "07/08/2022".

SECTION 260500
GENERAL REQUIREMENTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to all Division 26 Specification Sections.

1.2 INTENT OF DOCUMENTS

- A. The intent of the drawings and specifications is to obtain complete systems furnished, installed, tested, adjusted and ready for operation per industry standards, applicable codes and manufacturer's recommendations.
- B. Incidental materials and details not typically shown or specified, but required for proper installation and operation shall be deemed part of this Specifications and shall be provided.

1.3 REFERENCED CODES & STANDARDS

- A. Agencies or publications referenced in this Specification refer to the following:

- 1. ADA Americans with Disabilities Act
- 2. AEIC Association of Edison Illuminating Companies
- 3. AHJ Authority Having Jurisdiction
- 4. ANSI American National Standards Institute
- 5. ASME American Society of Mechanical Engineers
- 6. ASTM American Society for Testing and Materials
- 7. BICSI Building Industry Consulting Services International
- 8. EIA Electronic Industries Association
- 9. FCC Federal Communications Commission
- 10. IBC International Building Code
- 11. ICEA Insulated Cable Engineers Association
- 12. IEEE Institute of Electrical and Electronics Engineers
- 13. IESNA Illuminating Engineering Society of North America
- 14. IFC International Fire Code
- 15. NEC National Electrical Code
- 16. NECA National Electrical Contractors Association
- 17. NESC National Electrical Safety Code
- 18. NETA National Electrical Testing Association
- 19. NFPA National Fire Protection Association
- 20. NIST National Institute of Standards and Technology
- 21. OSHA Occupational Safety and Health Administration
- 22. TIA Telecommunications Industries Association
- 23. UL Underwriters Laboratories, Inc.

- B. Work shall be performed in accordance with the latest edition of Codes and Standards unless indicated otherwise.
- C. Electrical equipment and material and their installation and connection shall strictly comply with the latest editions and applicable sections of the following Codes and Standards as well as additional applicable Codes and Standards referenced in the technical Sections of this Specification for the products and systems to be provided.

NFPA 70 - National Electrical Code (NEC)
NFPA 101 - Life Safety Code
International Building Code (IBC)
International Fire Code (IFC)
National Electrical Safety Code (ANSI-C2)
Americans with Disabilities Act

- D. Rules, regulations and ordinances of Federal, State and Local Authorities and Utility Companies in force at the time of execution of this Contract shall become part of this Specification.
- E. All equipment and material shall be manufactured in compliance with applicable NEMA, ANSI and NEC standards and requirements.
- F. All electrical equipment and materials provided shall be listed by Underwriter's Laboratory (UL) when such listings are issued for the type of equipment or materials. All equipment/material shall be installed and connected in full compliance with their UL listing.

1.4 CONTRACTOR QUALIFICATIONS

- A. The Electrical Contractor shall be licensed in the State in which the project is located as an Electrical Contractor with Electrical Contracting as their primary business function. The Electrical Contractor's on-site project Superintendent shall be a licensed Journeyman Wireman (JW) or similar recognized licensing and shall be familiar with the systems, equipment and materials; their installation, connection and operation; and associated governing codes and standards typical for the type of facility(ies) being constructed as part of this project. The Electrical Contractor's Superintendent shall be on-site whenever any electrical construction work for this project is being performed.
- B. The successful Electrical Contractor shall submit to the Professional within 2 weeks of award of the project Contract and prior to any electrical construction work being performed a resume on his proposed project Electrical Superintendent for approval. The Superintendent's resume shall include a minimum of 5 previously performed projects of similar scope and complexity within 10 years of this project's contract date in which he was the project superintendent. For each project listed include an electrical construction cost, general description of the electrical work performed, Owner/Using Agency's name and a contact person with phone number.
- C. It is not the intent of this Specification to reiterate or list all the requirements of the published Codes and Standards applicable to this project. It shall be the Contractor's

responsibility to be familiar with, understand and adhere to the minimum requirements of the applicable Codes and Standards. Where this Specification requires more stringent requirements than the applicable Codes and Standards, this Specification shall govern.

- D. By submitting a price or bid for the work associated with this project, the Electrical Contractor testifies that he has adequate experience in the type of work to be performed and the systems to be provided to satisfactorily complete the project, and that he is familiar with the applicable Codes and Standards.

1.5 SUBMITTAL REQUIREMENTS

- A. Refer to and comply with Division 01 - Submittal Procedures.
- B. Submit to the Professional appropriate shop drawings and product data for equipment and material for the electrical systems indicated in the technical Sections of the Specifications. Submittals shall be provided for approval for indicated equipment or material whether or not substituted equipment or materials.
- C. Shop Drawing Log: The Contractor shall provide, as a separate submittal prior to submitting any Product Data/Shop Drawings or included with his first submittal for the project, a Log of Shop Drawings/Product Data to be provided as part of the project. The Log shall include the following information as a minimum:
 - 1. Title/Heading Lines including:
 - a. Project Name
 - b. General Contractors Name
 - c. Electrical Contractors Name and Contact Information
 - d. Date - This date shall be changed to reflect future updates and changes to the log.
 - 2. Submittal Information for each Submittal in Table Format including:
 - a. Submittal Number, if assigned as part of the project submittal tracking.
 - b. Associated Specification Section Number.
 - c. Specification Section Name.
 - d. Specific Equipment Description.
 - e. Date Submitted or Date to be Submitted.
 - f. Column(s) for Indicating Review Status: Approved, Approved as Noted, Rejected, etc.
 - g. Date of Approval.
- D. Shop Drawings and Product Data shall be submitted in electronic format using pdf files as follows:
 - 1. Shop Drawings and Product Data shall be separated into separate pdf files with one file for each Technical Section of the Specifications in which information is being provided.
 - 2. PDF files shall be originally generated files and shall not be scanned or faxed reproductions.

3. All information listed on the shop drawings shall be typed. Handwritten notations or information are not acceptable.
 4. Any notations made by the Contractor shall be in a legible color other than "red".
 5. Each pdf file shall have a Title Page indicating the following as a minimum:
 - (a) Project Name and Address
 - (b) Electrical Contractor Company's name, address and contact information.
 - (c) Electrical Distributor Company's name, address and contact information.
 - (d) The Specification Section Number and Name.
 6. Each pdf file shall have an Index Page indicating the following as a minimum:
 - (a) The Specification Section Number and Name.
 - (b) An index style general listing of the type of equipment/material included.
 - (c) Space for the Electrical Professional's review stamp and comments. This space shall be clearly labeled as to its use and shall have a minimum size of 7" wide X 5" high.
 7. Samples: Submit the number stated in each technical section of this Specification.
- E. All submitted equipment/material and associated options, accessories, special features, etc. shall be clearly marked and indicated on the shop drawings by highlighting or underlining in distinguishable color. Provide appropriate shop drawings on all required accessory equipment.
- F. For all substituted equipment or material, the Contractor shall clearly indicate on the shop drawings or product data sheets a deviation statement indicating all variations in dimensions, function, operation, installation, connection, etc. of the proposed substitution equipment or material. Failure to provide this information shall be interpreted to mean that the proposed substituted equipment is identical to the specified equipment in all respects.
- Substituted equipment or material provided and found to not be equal to the specified equipment and whose submittal documents did not indicate the deviation(s) from the specified equipment shall be replaced at the Contractor's expense with equal equipment or material whether or not installed, connected and/or energized.
- G. All shop drawings for all systems, equipment and materials including any required one-line drawings, diagrams, etc. from all sections of the Specification shall be submitted together. Partial submittals will not be reviewed without prior consent.
- H. Do not submit shop drawings for equipment/material that is not requested in this Specification.
- I. The Professional's review and approval of the shop drawings is only for general conformance with the design concept of the Project and the information given in the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site; information that pertains solely to the fabrication process

or to the means and methods of construction; coordination of work of all trades; and performing all work in a safe and satisfactory manner. Review and/or approval of the shop drawings does not modify the Contractor's duty to comply with the Contract Documents. Any equipment or work found in the judgement of the Professional to be defective or otherwise unsuitable due to substituted equipment or material shall be repaired or replaced by the Contractor at no additional cost to the Owner.

1.6 SUBMITTALS

- A. Electrical Contractor qualifications and certifications.
- B. Project Electrical Superintendent resume, qualifications, licenses and certifications.

1.7 COORDINATION

- A. This Contractor shall familiarize himself with the general construction and building systems of all divisions specified in the Contract Documents. Fully coordinate the installation of all electrical equipment and materials with the general construction work and work of other divisions of the specifications prior to the start of the installation. Notify the Professional, prior to installation, of conflicts between electrical and structural, architectural, mechanical, etc. work.
- B. Layout and installation of Division 26 work shall be the responsibility of this Contractor and all conflicts with other trades shall be resolved by the Contractor and approved by the Professional prior to installation.
- C. Sequence, coordinate and integrate installing electrical equipment and materials for efficient flow of the work. Coordinate the installation and positioning of large equipment before closing in the building. Providing appropriate pathways, lifting devices, etc. for the installation of electrical equipment and/or materials in new or existing facilities is the responsibility of this Contractor.
- D. Fully coordinate prior to installation all Utility Company services including metering facilities for the facility with the appropriate serving Utility Company. Comply with the requirements of the serving Utility Companies.
- E. Electrical drawings are not to scale. Follow architectural, equipment supplier shop drawings, and manufacturer's shop and installation drawings for accuracy. Coordinate the installation of electrical devices, equipment and/or materials with the architectural drawings, features and finishes for the space where installed.

1.8 TEST & OBSERVATIONS

- A. The complete project shall be, during and/or after construction, subject to the tests and observations as herein specified and as indicated on the Drawings. Deficiencies found as a result of these tests and observations shall be corrected by the Contractor within a reasonable period and at no expense to the Owner.

- B. The complete project shall be subject to observations and tests conducted by the Professional or for him in his presence. Upon notice, the Contractor shall furnish not to exceed two men, one to include the project Superintendent, and required tools to assist and be directed by the Professional for a reasonable amount of time to make such tests and observations as are requested by the Professional.
- C. The complete project shall be subject to observations and tests conducted by any Federal, State and/or local authority having jurisdiction. The Contractor shall make all corrections of any deficiencies required by the authority having jurisdiction to allow building occupancy.
- D. The complete project shall be subject to observations and tests conducted by the Owner's Insurance carrier. After inspection by this agency, Contractor shall make corrections of any deficiencies found adversely affecting the insurance to be carried by the Owner. Acceptance of this report or subsequent reports lie with the Professional or Owner.

1.9 RECORD DOCUMENTS

- A. Refer to and comply with Division 01 - Contract Closeout.
- B. In addition to the requirements of Division 01, the Contractor shall provide to the Professional with the Close-Out Documents the following:
 - 1. Scanned drawings in pdf format of same scale as original drawings indicating "as built" conditions of the work legibly marked in red showing all variations in the installed work from the requirements of the original Contract Documents. The "as-built" drawings shall include all addenda, approved and installed change orders, field condition changes and other departures from the original Drawings and Specifications.
 - 2. Electronic files in pdf format of the approved shop drawings reflecting the manufacturer's shop fabrication of the equipment and materials actually installed and the approved product data information required by this Specification.
 - 3. Operation and maintenance manuals and manufacturer's instructions for all equipment and systems installed.
 - 4. Copy of all reports of system, equipment or material test as required by this Specification.

1.10 WARRANTY

- A. Refer to and comply with Division 01 for general warranty requirements.
- B. The Contractor shall guarantee to the Owner all work performed under this contract to be free from defects in workmanship and materials for a period of one year from the date of final acceptance by the Professional and the Owner except as hereinafter noted.

- C. Refer to technical sections for specific additional warranty requirements and/or time frames.
- D. The Contractor shall correct, repair and/or replace upon notice from the Owner or his authorized representative within a reasonable period of time any defects in the work performed under this Contract arising during the warranty period.
- E. Warranty repair work shall include labor, material and travel and shall be provided at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL & EQUIPMENT

- A. Use only new equipment and materials of current manufacturer. Equipment/material shall be of current production from manufacturers' of long experience in the manufacture of such types of equipment/material and who are regularly engaged in the production of this type of equipment/material.
- B. Notwithstanding any reference in the specifications to any equipment, material or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Where the phrase "or approved equal" is used in the Division 26 Specification, substitute equipment, equivalent in all respects to that specified, of any qualified manufacturer is permitted with the written approval of the Professional. Approval will not be considered until after award of contract and only if submitted by the successful Contractor. Where a list of manufacturers and/or catalog numbers is provided and the phrase "or approved equal" is omitted, substitute equipment, equivalent in all respects to that specified, from one of the listed manufacturers is permitted with the written approval of the Professional.
- C. Equipment is specified by manufacturer's name and catalog number and is intended to establish the minimum standards of quality acceptable. The manufacturer's name and/or catalog number first mentioned in this Specification shall be considered the specified equipment. The "or equal" manufacturers mentioned or other manufacturers proposed by the Contractor shall be considered as substituted equipment.
- D. Substituted equipment shall meet the dimensional and functional requirements of the building as represented by the Drawings and Specifications. All revisions to the contract precipitated by the use of substituted equipment shall be incorporated by the Contractor, after approval in writing by the Professional, and at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE & HANDLING

- A. Deliver products to the construction site under provisions of Division 01.
- B. Store and protect products under provisions of Division 01 and the associated manufacturer's recommendations.
- C. Store all electrical equipment and material in a clean, dry space.
- D. Maintain factory wrapping or provide suitable protective covering to protect equipment from dirt, water, construction debris, traffic, etc.
- E. Handle in accordance with manufacturer's written instructions. Handle carefully to avoid damage to components, enclosures and finish. Lift only with lugs provide for the purpose.
- F. Provide supplemental heat if required to prevent moisture contamination.

3.2 GENERAL EQUIPMENT INSTALLATION

- A. Equipment and materials shall be installed and connected in strict compliance with manufacturer's recommendations unless these requirements are exceeded as indicated on the Drawings or specified herein.
- B. Perform all work in a "neat and workmanlike" manner as defined in ANSI/NECA 1, Standard for Good Workmanship in Electrical Contracting.
- C. Install equipment and materials level, plumb, and parallel and perpendicular to other building systems' elements and components unless otherwise indicated.
- D. Install equipment to facilitate service, maintenance, and repair or replacement of components.
- E. Install electrical equipment with required "working space" clearances and "dedicated equipment spaces" per NFPA 70 (NEC).
- F. Install electrical equipment and associated raceways and accessories to permit access to equipment for maintenance, removal, repair or changes. Do not install electrical equipment in a manner to block required access to non-electrical equipment or components.
- G. Electrical equipment and devices shall be mounted at the height specified in the technical sections of this Specification or as indicated on the drawings. Mounting heights may be adjusted slightly to permit cutting of masonry block to the top or bottom of the block course nearest the required height. All heights shall be consistently cut above or below the block coursing so that they are the same height above the reference.

- H. The mounting heights of electrical equipment and material shall reference the height above the finished floor or grade above which they are mounted. Mounting heights specified shall reference the center of the box, device, switch or circuit breaker operating handle unless indicated otherwise.
- I. Locate electrical outlets and equipment to fit details, panels, decorating or finishes at space. The Professional may direct the Contractor to move the location of any outlet or equipment connection and associated raceways up to 10 feet in any direction within the same space from the location indicated on the drawings if so directed prior to the installation of the work.

3.3 EQUIPMENT SUPPORTS

- A. Provide supporting steel not indicated on the drawings as required for the installation of electrical equipment and materials including angles, channels, beams, hangers, etc. Support steel located out of doors or in wet or corrosive environments shall be hot-dipped galvanized.

3.4 IDENTIFICATION

- A. Refer to Section 260553 "Electrical Systems Identification" and associated technical sections of this Specification.

3.5 FIRE STOPPING

- A. Openings around electrical penetrations through smoke and/or fire rated wall, partition, floor or ceiling assemblies shall be smoke and/or fire stopped using an approved UL listed system designed for the materials encountered to maintain the smoke and/or fire rating of the assembly.
- B. All fire proofing in rated walls, partitions, floors or ceiling assemblies shall be performed by a certified Fire Proofing Contractor. The Division 26 Contractor shall be responsible for procuring and coordinating with the Fire Proofing Contractor to provide the required fire proofing of all electrical penetrations in or through rated assemblies.

3.6 CUTTING & PATCHING

- A. Refer to the General Conditions of the Contract and Division 01 - Cutting and Patching.
- B. Cut, channel, chase and/or drill floors, walls, partitions, ceilings and other surfaces required to permit electrical installations. Obtain permission in writing from the Professional and the General Contractor prior to cutting or penetrating any structural member.
- C. Repair and refinish disturbed finish materials and other surfaces indoors and out-of-doors to match adjacent undisturbed surfaces and/or to existing condition prior to work performed.

- D. Use experienced and skilled mechanics of the trades involved or employ appropriate sub-contractor to perform all repair and refinishing.
- E. All roof penetrations shall be weatherproofed by the Division 07 Contractor. Division 26 Contractor shall be responsible for procuring and coordinating with the Division 07 Contractor to weatherproof all roof penetrations created by the Division 26 work. Roof work shall be performed by the proper personnel and in a manner to maintain any Roof Warranty.

3.7 CLEANING & PROTECTING

- A. Properly protect equipment and installations during the construction period to ensure that components, coatings, finishes, cabinets and enclosures are without damage or deterioration at the time of acceptance by the Owner.
- B. On completion of construction within an area, inspect exposed finish of outlets, devices, fixtures, equipment, etc. Remove burrs, dirt, paint spots and construction debris.
- C. Remove construction debris from all electrical enclosures prior to energizing.
- D. Provide touch-up paint on equipment finishes marred during the construction or installation process. Paint shall be as recommended by the equipment manufacturer and shall match the installed equipment finish.
- E. Where louvers and vent panels are provided in electrical equipment for cooling purposes, vacuum free of dust, dirt and debris. Provide new filter medium after construction site clean up.

END OF SECTION

**SECTION 260505
SELECTIVE ELECTRICAL DEMOLITION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 EXISTING CONDITIONS

- A. This project requires renovations and/or additions to existing facilities, additions and modifications to existing systems and associated demolition. The Contractor is responsible for visiting the site and verifying all existing conditions prior to bid and making necessary adjustments to the electrical installations to accommodate the existing conditions.

1.3 FIELD CONDITIONS

- A. Owner Occupancy:

- 1. The Owner will occupy portions of or adjacent facilities during the demolition and construction periods.

- B. Project Phasing:

- 1. The required demolition and construction shall be phased to allow Owner's occupancy and use of the facility or portions of the facility.
 - 2. Refer to the Professional's phasing plan and directions.

- C. Testing of Existing Systems:

- 1. Prior to the beginning of any new work or demolition, the Contractor shall review and test the existing system(s) to be modified and note in writing to the Professional any deficiencies or visible code violations. It is advised that the condition and operation of existing systems in close proximity to the new work be noted as well. These notations will be used to determine the responsibility of the final operating condition of systems at the completion of the project.

1.4 DEFINITIONS

- A. Disconnect and Remove: Disconnect equipment from electrical power source. Remove serving electrical branch and/or feeder circuits including raceways and conductors. Remove safety disconnect switches, control panels, operator stations, etc. Place serving overcurrent protection device in the "Off" position and label as spare unless reused in new work.

- B. Disconnect: Disconnect equipment from serving branch and/or feeder circuits. Remove serving electrical branch and/or feeder circuits including raceways and conductors back to safety disconnect switch. Place serving overcurrent protection device in the "Off" position and re-label.
- C. Disconnect and Reinstall: Disconnect equipment from electrical power source. Remove serving electrical branch and/or feeder circuits including raceways and conductors. Remove safety disconnect switches, control panels, operator stations, etc. Place serving overcurrent protection device in the "Off" position and label as spare unless reused in new work. Maintain and protect equipment for reinstallation and/or relocation under new work.
- D. Existing to Remain: Existing items that are not to be disconnected, disconnected and removed or dismantled. Maintain and protect throughout construction period.

1.5 DEMOLISHED MATERIALS OWNERSHIP

- A. The Owner shall have first rights of salvage of all demolished equipment and/or material. Demolished equipment and/or material not retained by the Owner shall become the property of the Contractor and shall be removed from the site.
- B. Properly dispose of all demolished equipment, material and debris per applicable governmental laws and regulations.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Electrical Equipment & Material: Verify that all electrical services to equipment have been placed in the "Off" position at the source of power and properly locked and tagged.
- B. Area or Space Demolition: Verify that all electrical branch circuits and feeder circuits serving the area or space in which demolition is being performed have been de-energized and disconnected and removed or properly locked-out and tagged-out if to remain.
- C. Building Demolition: Verify that all electrical service entrances to the facility have been physically disconnected from their source of power.

3.2 REQUIREMENTS

- A. Area or Space Demolition: In the areas shown on the Drawings to be renovated, other areas specifically noted, or as required for the installation of the new work, disconnect and remove all existing electrical equipment, lighting luminaires, wiring devices, etc. and associated branch circuits unless indicated on the Drawings or herein specified otherwise. Removal of branch circuits shall include exposed conduits, surface boxes and conductors back to next in-line active device, junction or over-current protection device.
- B. Equipment Services:
1. Equipment To Be Removed: Disconnect and remove existing electrical service(s) including but not limited to final connections, disconnect switches, branch circuits, control panels, etc. Unless specifically indicated to be removed or space is required in existing electrical distribution equipment for new electrical services, serving circuit breaker shall become spare and shall be labeled as such and left in the Off position.
 2. Equipment To Be Replaced: Where indicated on the Drawings for new equipment to be connected to the existing branch circuit(s) that served the removed equipment, provide the following:
 - a. Existing Disconnect Switch & Branch Circuit(s) To Remain: Provide and connect new final connection branch circuit(s) from existing disconnect switch(es) to new equipment connection point(s). Branch circuit(s) conduit & conductors shall match existing construction unless indicated otherwise.
 - b. Existing Branch Circuit To Remain: Provide and connect new disconnect switch(es) as indicated. Extend and connect existing branch circuit(s) to associated new disconnect switch(es). Provide and connect new final connection branch circuit(s) from disconnect switch(es) to new equipment connection point(s). Branch circuit(s) conduit & conductors shall match existing construction unless indicated otherwise.
 3. If existing electrical services or a portion thereof are not specifically indicated to be reused for the connection of new or replacement equipment, the electrical service(s) shall be new.
- C. Lighting Luminaires, Wiring Devices, Feed-Thru Devices: Disconnect and remove indicated luminaires and devices and associated outlet box(es) and serving branch circuit(s). Remove branch circuit back to next in-line active outlet box(es) or junction box(es). Reroute, relocate, refeed, etc. feed-thru branch circuits interrupted by demolition and serving remaining active outlets.
- D. Electrical Service & Distribution System: Disconnect and remove the existing electrical service entrance equipment, electrical distribution equipment and associated feeder circuits unless indicated on the Drawings or herein specified otherwise. Removal of feeder circuits shall include exposed conduits, surface boxes and conductors back to over-current protection device.

3.3 RACEWAY DEMOLITION

- A. Surface and Exposed Raceways serving Demolished Equipment: Disconnect and remove including boxes, conduits and conductors.
- B. Concealed or Abandoned Raceways serving Demolished Equipment: Cut back flush with finish or surface and cap. Provide blank plate or cover on all abandoned flush mounted junction boxes in existing walls to remain without new finishes.

3.4 CIRCUITS TO REMAIN

- A. Maintain and restore, if interrupted, all existing feed-thru feeder and/or branch circuits serving areas not under renovation, other areas outside the scope of this project or existing equipment to remain.
- B. Reroute and connect as indicated, as directed or required all existing branch and feeder circuits routed through areas of demolition that will conflict with the new construction. Raceways and conductors required to accomplish this work shall be sized per the existing rerouted circuit and connected to the existing circuit by specified splicing methods in a properly sized junction box unless indicated on the Drawings or herein specified otherwise.
- C. Comply with NFPA 70 (NEC).

3.5 CLEANING

- A. Clean adjacent equipment, finishes and improvements of dust, dirt and debris caused by electrical demotion operations.

END OF SECTION

**SECTION 260507
ELECTRICAL SERVICE SYSTEM UTILITY COORDINATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to all Division 26 Specification Sections.

1.2 INTENT OF DOCUMENTS

- A. The intent of the drawings and specifications is to provide new, upgraded or relocated electrical service(s) to the facility(ies) as indicated on the drawings complying with NFPA 70 (NEC), NESC/ANSI C2, and the standard electrical service requirements and specifications of the serving electrical Utility Company.

1.3 COORDINATION

- A. Prior to any electrical construction, the Division 26 Contractor shall arrange and conduct a meeting at the project site with an appropriate representative(s) of the serving Utility Company to review and verify all the electrical service provisions specified on the Drawings and Specifications for the project including but not limited to:
 - 1. Routing of overhead/underground primary circuits.
 - 2. Location of primary riser pole(s).
 - 3. Size, number and material of underground raceways.
 - 4. Location and size of pullboxes in underground circuits.
 - 5. Transformer types: pole-, platform- or pad-mounted.
 - 6. Transformer(s) location, orientation, clearances, access, etc.
 - 7. Secondary service entrance requirements.
 - 8. Utility Disconnect Switch requirements, location, mounting, etc.
 - 9. Utility Metering requirements and equipment to be provided by the Contractor.
 - 10. Secondary service voltage, phase and ampere rating.
- B. The before mentioned Utility Company meeting shall occur prior to ordering any material or performing any rough-in associated with the electrical service and distribution systems.
- C. The Contractor shall notify the Professional of any changes in the project required to meet the Utility Company's requirements. Failure to conduct and attend the Utility Company Meeting and verify the requirements of the serving Utility Company prior to ordering or installing equipment and or material shall make this Contractor responsible for all corrections and/or changes to installed/purchased equipment, materials, etc. and associated rough-ins required to comply with the Utility Company's requirements at no additional cost to the Owner.

1.4 ELECTRICAL SERVICE ALLOWANCE

- A. The Division 26 Contractor shall include in his bid price an allowance in the sum of \$25,000.00 to be paid to the serving Utility Company for portions of the installed permanent electrical service not normally furnished under their standard service policy. Any charges from the Utility Company under or above this amount, respectively, shall be credited to the Owner or added by Change Order to the contract.
 - 1. This allowance shall be identified on the project Schedule of Values and all Pay Applications as a separate line item.

PART 2 - PRODUCTS

2.1 RACEWAYS

- A. Provide raceways as indicated on the Drawings unless directed in writing by the serving Utility Company otherwise.
 - 1. Notify the Professional in writing of any Utility Company requested changes or modifications to the requirements of the Contract Documents prior to ordering any associated equipment or material or installation of same.
- B. Comply with Section 260533 "Raceways & Boxes for Electrical Systems" and Section 260543 "Underground Ducts & Raceways for Electrical Systems" when included in the Specifications.
- C. Size, number and type of material of raceways associated with Utility Company equipment or cable shall comply with the requirements of the Utility Company.

2.2 IN-GRADE PULLBOXES

- A. Provide in-grade pullboxes in raceways and duct bank for Utility Company cabling and conductors as indicated on the Drawings or as directed by the serving Utility Company.
- B. Size, depth, configuration, etc. of pullboxes for Utility Company cabling, conductors or equipment shall comply with the requirements of the Utility Company.
- C. Verify location of pullboxes with the serving Utility Company prior to installation.
- D. As a minimum, comply with Section 260533 "Raceways & Boxes for Electrical Systems" and Section 260543 "Underground Ducts & Raceways for Electrical Systems" when included in the Specifications.

2.3 MANHOLES

- A. Provide manholes for Utility Company cabling, conductors and equipment as indicated on the Drawings.

- B. Size, depth, layout, construction, configuration, accessories, etc. of manholes for Utility Company use shall comply with the requirements of the serving Utility Company.
- C. As a minimum, comply with Section 260543 “Underground Ducts & Raceways for Electrical Systems” when included in the Specifications.

2.4 UTILITY DISCONNECT SWITCH

- A. Size, construction, configuration, type, mounting, etc. per the serving Utility Company’s requirements and specifications.
- B. Ampere rating, voltage rating and number poles to match electrical service entrance equipment ratings. Provide and connected ground bus and isolated neutral bus.
- C. Utility Disconnect Switch Type
 - 1. Rated 1200A and Smaller: Disconnect Switch, non-fused type, pad-locking provisions, wall-mounted, NEMA rated enclosure per the requirements of Section 262816 “Enclosed Switches & Circuit Breakers”.
 - 2. Rated Greater than 1200A: Enclosed Circuit Breaker with pad-locking provisions in the Off position, free-standing NEMA rated enclosure per the requirements of Section 262816 “Enclosed Switches & Circuit Breakers”.
 - a. Utility Disconnect Switch shall not function or be connected as Electrical Service Entrance Equipment unless indicated on the Drawings to be connected and function in this capacity.

2.5 CT ENCLOSURES

- A. Size, dimensions, material, layout, construction, configuration, accessories, mounting, etc. per the serving Utility Company’s requirements and specifications.

2.6 METER SOCKETS

- A. Provide self-contained or transformer-rated meter sockets as indicated on the Drawings or as directed by the serving Utility Company.
- B. Size, dimensions, ampacity, material, construction, configuration, accessories, mounting, etc. per the serving Utility Company’s requirements and specifications.

2.7 CONCRETE EQUIPMENT PADS

- A. Size, dimensions, depth, concrete rating, reinforcement, configuration, etc. per the serving Utility Company’s requirements and specifications.

PART 3 - EXECUTION

3.1 GENERAL EQUIPMENT INSTALLATION

- A. Comply with Section 260500 "General Requirements for Electrical Systems".
- B. Comply with Section 260533 "Raceways & Boxes for Electrical Systems" and Section 260543 "Underground Ducts & Raceways for Electrical Systems" when included in the Specifications.
- C. Comply with serving Utility Company specifications, requirements, written directions, etc.

END OF SECTION

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Copper Conductors, rated 600V or less.
2. Connectors, Splices and Terminations rated 600V or less.

B. Related Sections:

1. Division 7 Section "Penetration Firestopping".

1.2 REFERENCES

- A. ANSI/IEEE C2 - National Electrical Safety Code.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. ANSI/UL 467 - Grounding and Bonding Equipment.
- D. ASTM B 1 - Standard Specification for Hard-Drawn Copper Wire.
- E. ASTM B 8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- F. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-19-81).
- G. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-61-402).
- H. UL 44 - Thermoset-Insulated Wires and Cables.
- I. UL 83 - Thermoplastic-Insulated Wires and Cables.
- J. UL 486A-486B - Wire Connectors.
- K. UL 486C - Splicing Wire Connectors.
- L. UL 486D - Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
- M. UL 2196 - Standard for tests for Fire Resistive Cables.

1.3 DEFINITIONS

- A. Branch Circuit: An electrical power circuit consisting of the overcurrent protection device, the power and equipment grounding conductors, the raceway system, the safety disconnect device (when required by Code) and the final connection to the outlet, device or equipment.
- B. Branch Circuit Homerun: The power and equipment grounding conductors and associated raceways connecting the branch circuit overcurrent device(s) to an outlet box for electrical connection to a device or equipment or to a homerun junction box for separation of the individual branch circuit conductors for routing to their respective loads when conductors for multiple branch circuits are combined in the same raceway.
- C. Homerun Junction Box: A junction or outlet box in a branch circuit raceway system where all of the associated branch circuit conductors are combined into a single raceway for routing to the serving electrical distribution equipment. A Homerun Junction Box shall be located in an accessible location as close to the connected outlets, devices and equipment served by the associated branch circuits as reasonably possible.

1.4 SUBMITTALS

- A. Refer to Section 260500 "General Requirements for Electrical Systems" for additional requirements.
- B. Product Data:
 - 1. Listed Manufacturer: None Required.
 - 2. Proposed Equal Manufacturer: For each type of proposed product.

1.5 SUBMITTALS FOR CLOSE-OUT

- A. Field Acceptance Test Reports on installed low-voltage power conductors.

1.6 DELIVERY, STORAGE & HANDLING

- A. Visually inspect conductors prior to installation and during installation for damage and signs of mis-handling.
- B. Store in a clean, dry space. Protect from dirt, fumes, water, corrosive substances and construction debris.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- A. Southwire Company
- B. General Cable Corporation
- C. American Insulated Wire Corporation; a Leviton Company

- D. Approved Equal

2.2 COPPER CONDUCTORS

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70 (NEC) by a qualified testing agency and marked for intended location and use.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- D. Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.

2.3 CONNECTORS & SPLICES

- A. Description: Factory-fabricated connectors, splices and lugs of size, ampacity rating, material, type and class for application and service indicated; compatible with indicated conductors; listed and labeled as defined in NFPA 70 (NEC) by a qualified testing agency and marked for intended location and use.
- B. Lugs: One piece, seamless, compatible with indicated conductor.
 - 1. Material: Copper or Aluminum.
 - 2. Type: One or two hole with standard barrel as required for termination.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. All power conductors shall be copper.
- B. Conductors #10 AWG and smaller shall be solid. Conductors #8 AWG and larger shall be stranded. All final connections to motors and vibrating equipment shall be made with stranded conductors.
- C. Minimum Conductor Sizes shall be as follows:
 - 1. Power Conductors: #12 AWG minimum.

2. Control/Signal Systems: #14 AWG minimum unless indicated otherwise.

D. Branch Circuit Wiring Length Limitations:

1. 208Y/120V Branch Circuits over 100 feet in Length: Increase conductor size one size for each 100 feet of length. Increase raceway size as required in compliance with NFPA 70 (NEC).
2. 480Y/277V Branch Circuits over 150 feet in Length: Increase conductor size one size for each 150 feet of length. Increase raceway size as required in compliance with NFPA 70 (NEC).

3.2 CONDUCTOR INSULATION APPLICATIONS

- A. Electrical Service Entrance: Type THHW, THWN, XHHW-2, rated 90°C for wet locations, single conductor in raceway.
- B. Underground Feeder Circuits: Type THWN-2, rated 90°C for wet locations, single conductor in raceway.
- C. Feeder Circuits: Type THHN/THWN-2, rated 90°C for dry and wet or damp locations, single conductor in raceway.
- D. Branch Circuits: Type THHN/THWN-2, rated 90°C for dry and wet or damp locations, single conductor in raceway
- E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS

- A. All power conductors shall be installed in conduit and raceway systems unless specifically indicated otherwise.
- B. Install conductors only after:
 1. Building interior is enclosed and weather-tight.
 2. Raceway system installation, connection, termination and support is complete.
 3. Mechanical work likely to damage conductors has been completed.
- C. Use manufacturer-approved pulling compound or lubricant where necessary. Compound used shall 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.
- E. Support cables and conductors according to Section 260529 "Hangers and Supports for Electrical Systems."

- F. All 120V and 277V branch circuits shall have dedicated neutral conductor of same size as associated phase conductors.
- G. Neatly train and lace conductors inside boxes, equipment and panelboards.
- H. Branch Circuit Homeruns shall not exceed the number of circuits and conductors indicated on the drawings.
- I. Wiring at Outlets: Install conductors at each outlet with a minimum of 6 inches of slack.
- J. Provide crimp type lug on conductors where stranded conductors are terminated. Do not place bare stranded conductors directly under screw-type terminals.

3.4 CONNECTORS, SPLICES & TERMINALS

A. Connectors:

1. Except where equipment is furnished with bolted or screw type lug, use compression set pressure connectors with insulating covers. Use compression tools and die compatible with the connectors being installed.
2. When allowed, use compression-set type with application of insulating tape, pre-stretched or heat-shrinkable insulating tubing for splices and taps of #8 AWG conductors and larger. Install with hydraulic compression tool.
3. Use pre-insulated "twist-on" connectors (wire nuts) with integral spring for splices and taps of #10 AWG conductors and smaller. Push-on type connectors shall not be used.
4. Tighten electrical connections and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Splices:

1. 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.
2. Make splices and connections in accessible boxes, gutters or cabinets only.
3. Conductors #8 AWG and larger shall be spliced only with specific approval from the Professional.

C. Terminals:

1. Eye type crimped terminal for removable screw type terminal. Forked torque terminal when terminal screw can not be removed.
2. Train wires to eliminate fanning of strands, crimp with proper tool and die.
3. Torque screw termination per manufacturer's recommended values.

3.5 IDENTIFICATION

- A. Conductors of 600V and less electrical service entrances, feeder circuits and branch circuits shall have conductor insulation colors as listed below.
 - 1. Where conductor type, size, etc. does not allow specified insulation colors, conductors shall be identified using products specified in Section 260553 "Electrical Systems Identification" at each accessible location and termination.
- B. Color coding for 480/277V Circuits:
 - 1. Phase A: Brown, Phase B: Orange; Phase C: Yellow
 - 2. Neutral Conductor: Gray
 - a. Dedicated Neutral to Phase A: Gray with Brown tracer.
 - b. Dedicated Neutral to Phase B: Gray with Orange tracer.
 - c. Dedicated Neutral to Phase C: Gray with Yellow tracer.
 - 3. Equipment Ground: Green
- C. Color coding for 208/120V Circuits:
 - 1. Phase A: Black, Phase B: Red; Phase C: Blue
 - 2. Neutral Conductor: White
 - a. Dedicated Neutral to Phase A: White with Black tracer.
 - b. Dedicated Neutral to Phase B: White with Red tracer.
 - c. Dedicated Neutral to Phase C: White with Blue tracer.
 - 3. Equipment Ground: Green
- D. Color coding for 240/120V Circuits:
 - 1. Phase A: Black, Phase B: Orange (High Leg); Phase C: Red
 - 2. Neutral Conductor: White
 - a. Dedicated Neutral to Phase A: White with Black tracer.
 - b. Dedicated Neutral to Phase C: White with Red tracer.
 - 3. Equipment Ground: Green
 - 4. Single phase, 240/120V Color Coding similar without Phase B.
- E. Properly identify each spare conductor at each end with proper identification to locate other end and label as spare conductor.

3.6 FIELD QUALITY CONTROL

- A. Conductor insulation test shall be performed on all electrical service entrance conductors, switchboard/panelboard and transformer feeder conductors and branch circuit conductors #2 AWG and larger. An insulation test shall be performed on any feeder or branch circuit as requested by the Professional for trouble shooting purposes. The "600V Conductor Insulation Test Report" found at the end of this section shall be completed with test results and shall be submitted to the Professional prior to substantial completion of the project.

- B. 600 volt conductor insulation tests shall be performed using a 500 volt megger. Each conductor shall be tested with all splices made but no equipment or devices connected. Feeder/branch circuits with paralleled conductors shall have conductors tested separately prior to paralleling. The ohmic value measured shall be recorded and the results shall meet the minimum requirements of the conductor manufacturer. Conductors not meeting these minimum requirements shall be replaced or repaired as directed by the Professional.

END OF SECTION

SECTION 260526
GROUNDING & BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Grounding and bonding of electrical systems shall be in accordance with Article 250 of NFPA 70 (NEC).

1.2 REFERENCE STANDARDS

- A. ANSI J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- B. ASTM B 3 - Specification for Soft or Annealed Copper Wire.
- C. ASTM B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
- D. ASTM B 33 - Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- E. IEEE C2 - National Electrical Safety Code (ANSI).
- F. NETA MTS - Maintenance Testing Specifications.
- G. NFPA 70 (NEC) - National Electrical Code.
- H. UL 467 - Grounding and Bonding Equipment.

1.3 SUBMITTALS

- A. Product Data - None

1.4 CLOSEOUT SUBMITTALS

- A. Indicate on As-Built Drawings location and routing of Grounding Electrode System.
- B. Results of Grounding System Ground Resistance Testing.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements

1. Electrical Components, Devices and Accessories shall be listed and labeled as defined in NFPA 70 (NEC).
2. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper conductor insulated for 600V with insulation characteristics similar to current-carrying conductors.
 1. Insulation Color: Green or Green with Yellow Tracer.
- B. Bare Conductors: Copper
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Conductor: #4 or #6 AWG, stranded copper.
 5. Bonding Jumper: Copper Tape, braided conductors, terminated with copper ferrules, 1 5/8" wide and 1/16" thick.
 6. Tinned Bonding Jumper: Tin coated Bonding Jumper.
- C. Grounding Bus: Annealed copper with terminal screws as required for terminated conductors, ampere rating as indicated or per NEMA standards.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to the AHJ for applications in which used and for specific types, sizes and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by the manufacturer for materials being joined and installation conditions.
- C. Bolted Connectors for Conductors and Pipes: Copper or copper-alloy, bolted pressure type with a least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.
- D. Compression Connectors: Irreversible type.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, 3/4 inch diameter by 10 foot length.

2.4 GROUNDING BUSBARS

- A. Pre-drilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, 24 inches in length, with 9/32 inch connect holes per ANSI Joint Standard J-STD-607-A. Stand-off insulated mounting brackets for wall mounting.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Provide solid copper conductor for #10 AWG and smaller and stranded copper conductors for #8 AWG and larger unless indicated otherwise.
- B. Underground Grounding Conductors: Provide bare copper conductor, #2/0 AWG minimum or as indicated on the drawings.
- C. Grounding Busbar: Provide in telecommunication rooms and electrical room housing electrical service entrance equipment.
- D. Grounding Conductor Terminations and Connections:
 - 1. Pipe and Equipment Connections: Bolted connectors.
 - 2. Underground Connections: Exothermic-weld.
 - 3. Ground Rod Connections: Exothermic-weld.
 - 4. Structural Steel Connections: Exothermic-weld or irreversible compression type connector.

3.2 GROUNDING ELECTRODE SYSTEM

- A. Where new electrical service entrances are provided, provide and connect grounding electrode system consisting of grounding electrode conductor, driven ground rods, incoming metallic cold water pipe and building structural steel.
- B. The number of ground rods for the grounding electrode system shall be per the following or as required to obtain the maximum resistance to ground of the grounding electrode system to 10 ohms.
 - 1. Service Equipment Rating less than 400A: One ground rod minimum.
 - 2. Service Equipment Rating 400A to 799A: Two ground rods minimum.
 - 3. Service Equipment Rating 800A and greater: Three ground rods minimum.
- C. Ground Rods shall be installed with top a minimum 12 inches below the finished grade with a minimum distance between interconnect ground rods of 10 feet. Install ground rods in a straight line or triangular pattern.
- D. Grounding Electrode Conductor: Bare copper sized as indicated on the drawings or per NFPA 70 (NEC) Article 250 if size not indicated.

- E. Interconnect all grounding electrode system driven ground rods with continuous un-spliced grounding electrode conductor. Grounding electrode conductor shall extend unspliced along the shortest path possible and connect to the Ground Bus of the associated electrical service entrance equipment. Install grounding electrode conductor a minimum of 18 inches below finished grade.
- F. Route grounding electrode conductor from electrical service entrance equipment to beyond the building perimeter in Schedule 40 electrical-grade PVC conduit.
- G. The incoming metallic water pipe where present and of the proper characteristics shall be bonded to the grounding electrode system. Connection shall be made within 5 feet of the pipe's point of entry into the building and shall be accessible for inspection.
- H. The building's structural steel where present shall be bonded to the grounding electrode system and the connection shall be accessible for inspection.

3.3 GROUNDING AT ELECTRICAL SERVICE ENTRANCE

- A. Connect Grounding Electrode Conductor to ground bus of electrical service entrance equipment.
- B. Bond the electrical service entrance equipment grounded (neutral) bus and equipment grounding bus together with a Main Bonding Jumper (MBJ). MBJ shall be the same size as the indicated Grounding Electrode Conductor or equivalent factory installed bussing. The grounded (neutral) conductors and the equipment grounding conductors shall not be bonded together at any other location in the system except at separately derived systems as defined by NFPA 70 (NEC).
- C. Bond all sections, cubicles, conduits and non-current carrying metallic parts of the electrical service entrance equipment shall be bonded together and connected to the equipment grounding bus using a #6 AWG bare copper conductor.

3.4 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Where separately derived systems (i.e dry-type transformers, engine generators, etc.) are being provided, provide grounding electrode system at each separately derived system.
 - 1. Bond the grounded (neutral) bus to the equipment grounding bus or conductor by a main bonding jumper. This bonding shall occur within the equipment's enclosure at the connection terminals of each bus.
 - 2. Bond the grounded (neutral) bus to the nearest grounding electrode by a grounding electrode conductor. The grounding electrode may be the building's structural steel where effectively grounded and bonded to the electrical service entrance grounding electrode system, the incoming metallic water pipe where the connection can be made within five (5) feet of the pipes entry into the building and/or the building's electrical service grounding electrode system.

3. The grounding electrode conductor and the main bonding jumper of each separately derived system shall be bare copper sized as indicated on the drawings or per Article 250 of NFPA 70 (NEC) whichever size is largest. The grounding electrode conductor shall run continuous without splices and utilizing the most direct path from the separately derived system's grounded (neutral) bus to the grounding electrode(s). The grounding electrode conductor shall be routed in electrical grade Schedule 40 PVC conduit to the point of connection to the grounding electrode system. All connections of the grounding electrode conductor to the grounding electrodes shall be made by exothermic weld(s).
4. All metallic piping systems (water, natural gas, fire protection, etc.) located within the area served by the separately derived system shall be bonded to the separately derived system's grounding electrode system in accordance with Article 250 of the NFPA 70 (NEC).

3.5 EQUIPMENT GROUNDING

- A. Provide and connect insulated equipment grounding conductor in all feeders and branch circuits.
- B. Size of equipment grounding conductor for branch circuits: For branch circuits with #12 and #10 AWG phase conductors, size equipment grounding conductor the same size as phase conductors. For branch circuits with #8 or larger phase conductors, size equipment grounding conductor as indicated or per Article 250 of NFPA 70 (NEC) if size not indicated.
- C. Size of equipment grounding conductor for feeder circuits: Size as indicated or per Article 250 of NFPA 70 (NEC) if size not indicated.
- D. Bond equipment grounding terminal of all grounding-type power receptacles and devices to the equipment grounding conductor and to the outlet box or enclosure housing the device.
- E. Bond all metallic boxes, enclosures, wireways, etc. that are connected to the electrical power system to the equipment grounding conductor.
- F. Branch circuit conduits 1 1/4 inch and larger and all feeder circuit conduits shall be provided with a grounding bushing at all connections to an enclosure. Bond bushing together using #8 AWG bare copper equipment grounding conductor and then bond to enclosure at grounding equipment conductor lug or ground bus.
- G. Couple conduits together and connect to boxes, fittings and enclosures so as to provide effective electrical continuity. Assure ground continuity on all GRC feeder and GRC branch circuits 1 1/4 inch and larger by two locknuts, one inside and one outside the connected box or enclosure.
- H. All metallic piping systems (water, natural gas, fire protection, etc.) within or attached to the building shall be bonded to the grounding electrode system per NFPA 70 (NEC).

- I. Bond the building's structural steel to the grounding electrode system per NFPA 70 (NEC).
- J. Where a lightning protection system is provided or exist on the building, the lightning protection system's grounding electrode system shall be bonded to the electrical service entrance grounding electrode system using a same size bare copper conductor as the lightning protection system grounding electrode conductor.
- K. Manholes: Provide driven ground rod through floor, close to wall, and set rod depth so 4 inches will extend above the floor. Bond all exposed metallic components and parts within the manhole to the ground rod using #4 AWG bare copper conductor. Train conductors level and plumb around corners and fasten to manhole walls. Connect to medium-voltage cable armor and shields according to written instructions of manufacturer's of splicing and termination kits.
- L. Pad-Mounted Transformers and Switches: Provide two driven ground rods at opposite corners and provide ground ring around the equipment pad. Ground pad-mounted equipment per manufacturer's recommendations to the ground ring at ground rod connections. Ground ring and equipment grounding taps shall be #2/0 AWG bare copper minimum. Bury ground ring not less than 12 inches from the pad perimeter and a minimum of 18 inches below finished grade.
- M. Pole Supporting Outdoor Lighting Luminaires: Provide ground rod at each pole and bond to pole grounding terminal using #6 AWG copper conductor.
- N. Metallic Fences Around Electrical Equipment: Comply with the requirements of IEEE C2. Bond to equipment ground grid using #8 AWG minimum size copper conductor. Provide flexible bonding jumper and bond gates to the associated fence.
- O. Isolated Grounding Receptacle: In addition to the equipment grounding conductor in the serving branch circuit, provide an insulated and isolated grounding conductor and connect to the receptacle grounding terminal. Isolate the conductor from the raceway system and terminate on the isolated ground bus at the serving panelboard.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid placing conductors where they may be subjected to strain, impact or damage.
- B. Ground Rods: Drive rods until tops are 12 inches below finished grade unless otherwise indicated. Make all connections using exothermic welds.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
- D. Grounding for Steel Building Structure: Provide a driven ground rod at the base of each corner column and at intermediate exterior columns at distances not mor than 60

feet apart. Bond column to ground rod using #1/0 bare copper conductor. Exothermic weld all connections.

- E. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors and connection methods so metal in direct contact are galvanically compatible.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Provide inspection of all grounding and bonding connections. Inspect physical and mechanical condition. Verify tightness of accessible, bolted electrical connections.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified and at electrical service entrance equipment grounding terminal/bus.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform test by fall-of-potential method according to IEEE 81.

- B. Provide report for inclusion in Close-Out Documents indicating measure ground-resistance at the electrical service entrance equipment and other locations where maximum ground-resistance levels are specified.

- C. Where ground-resistance levels exceed specified values, promptly notify the Professional and include recommendations to reduce ground resistance.

END OF SECTION

**SECTION 260529
HANGERS & SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support systems.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components including mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.
7. Concrete housekeeping equipment pads.

1.2 SUBMITTALS

- A. Refer to Section 260500 "General Requirements for Electrical Systems" for additional requirements.
- B. Shop Drawings: Provide construction details, material descriptions, dimensions, profiles and finishes for the indicated equipment support assemblies.

1.3 REFERENCED STANDARDS

- A. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- B. ASTM A 36/A 36M - Carbon Structural Steel.
- C. ASTM A 325 - Structural Bolts, Steel, Heat Treated, 827/724 MPa Minimum Tensile Strength.
- D. ASTM A 780 - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- E. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
- F. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.
- G. MFMA-4 - Metal Framing Standards Publication.
- H. NECA 1 - Standard Practices for Good Workmanship in Electrical Construction.
- I. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).

- J. NFPA 70 - National Electrical Code.
- K. SSPC-PA 1 - Paint Application Specification No. 1: Shop, Field and Maintenance Painting of Steel.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Comply with NFPA 70 (NEC).

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE AND ATTACHMENT COMPONENTS

- A. Rated Strength: Adequate in tension, shear and pullout force to resist maximum loads calculated or imposed with a minimum structural safety factor of 5 times the applied force.
- B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Material for Channel, Fittings and Accessories: Galvanized Steel unless indicated otherwise.
 - 2. Channel Width: Selected for applicable load criteria, minimum 1 5/8 inches.
 - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane or polyester coating applied according to MFMA-4.
 - 5. Painted Coatings: Manufacturer's standard painted coating applies according to MFMA-4.
- C. Conduit and Cable Support Devices: Steel and malleable iron hangers, clamps and associated fittings designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes and bars; black and galvanized.
- F. Mounting, Anchoring and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical Expansion Anchors: Insert-wedge-type, stainless steel for use in hardened portland cement concrete with tension, shear and pullout capacities appropriate for supported loads and building materials used.
2. Concrete Inserts: Steel or malleable iron, slotted support system units similar to MSS Type 18, comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: MSS SP-58 threaded steel with adjusting and lock nuts.

2.2 FABRICATED METAL FRAMING EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural steel plates, shapes, tubes and bars. Shop or field fabricated to fit dimensions of supported equipment.
- B. Assemblies Installed Outdoors: Welded, hot-dipped galvanized after fabrication.
 1. Assembly Construction: Constructed of structural steel shapes, tubes and bars welded together to accommodate the equipment to be mounted. Length and height of assembly as required for mounted equipment.
 - a. Vertical Uprights: 6-inch steel channels, length as required, minimum 2 per mounting frame, 6-feet maximum spacing between vertical uprights. Set uprights in concrete with minimum depth 24-inches below finished grade with a minimum of 4-inches of concrete coverage on all sides.
 - b. Horizontal Members: 3-inch steel angle iron or tubing, length as required, minimum 2 per mounting frame, spacing as required for mounting of equipment, weld to vertical uprights.
 - c. Concrete Equipment Pad: Reinforced concrete pad per Specification Section "Cast In-Place Concrete", 3000 psi, 4-inch minimum thickness with minimum 8-inch turn-downs around perimeter. Pad dimensions shall be 12-inches beyond each end of equipment frame and provide a minimum of 36-inches of working depth in front of panelboards, control panels, etc. measured from the face of the largest enclosure.
- C. Assemblies Installed Indoors: Welded or bolted, galvanized components.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements of this Specification are stricter.

- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC and GRC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70 (NEC).
 - 1. Size steel hanger rods for individual and trapeze supports for supported load with specified structural safety factor.
 - 2. Minimum hanger rod size shall be 3/8 inch.
- C. Multiple Raceways or Cables: Provide trapeze-type supports fabricated with steel slotted or other support system. Size trapeze supports so that capacity and load can be increased by 25 percent without exceeding design load limits.
 - 1. Secure raceways and cables to trapeze supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1 1/2 inch and smaller raceways serving branch circuits and communication systems above accessible ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified herein.
- 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 for strength determination shall be weight of supported components plus 200 pounds.
- 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 Existing Concrete: Expansion anchor set in epoxy.
 - 4. To Masonry: Approved toggle-type bolt on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M with lock washers and nuts or beam clamps (MSS SP-58, 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 and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

- E. Do not support raceway by other raceway.
- F. Do not support equipment or raceway from metal roof decking or floor decking.
- G. Do not support or impose the weight of electrical equipment, raceways or lighting luminaires on support provided for other trade systems (i.e. suspended ceiling supports, mechanical equipment and piping supports, etc.).
- H. Where raceways are indicated to be routed on the roof, provide conduit mounting pedestals as required to support conduits. Maximum spacing of supports shall be 10 feet. Install pedestal on roof deck and flash into roofing material. Contract Roofing Contractor to perform all roofing work to water proof the installation. Roofing Contractor shall be certified by roof manufacturer as required to maintain any and all warranties.
- I. Punching, drilling or welding of building structural steel or welding attachment to building structural steel is not allowed unless approved in writing by the Structural Engineer.

3.3 CONCRETE HOUSEKEEPING PADS

- A. Construct concrete housekeeping pads for all floor-mounted electrical equipment except dry-type transformers 150KVA and smaller unless otherwise indicated.
- B. Dimensions: 3 inches high and not less than 2 inches larger in both directions than supported equipment so that anchors will be a minimum of 10 bolt diameters from the edge of the pad.
- C. Use 3000 psi, 28-day compressive-strength concrete. For concrete materials, reinforcement and placement requirements comply with Division 3 Section "Cast-In-Place Concrete".
- D. Anchor equipment to concrete pad as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions and directions furnished with the items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 FINISH TOUCH-UP

- A. Galvanized Surface: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 260533
RACEWAYS & BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Rigid non-metallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures and cabinets.
5. Handholes and boxes for exterior underground branch circuit wiring.
6. Raceway sleeves and sleeve seals.
7. Miscellaneous fittings and accessories.

B. Related Requirements:

1. Division 7 Section "Penetration Firestopping".

1.2 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

C. EMT: Electrical metallic tubing.

D. FMC: Flexible metallic conduit.

E. LFMC: Liquid-tight flexible metallic conduit.

F. RNC: Rigid non-metallic conduit.

G. PVC: Polyvinyl chloride.

H. HDPE: High density poly ethylene.

I. Circuit Definitions.

1. Branch Circuit: An electrical power circuit consisting of the overcurrent protection device, the power and equipment grounding conductors, the raceway system, the safety disconnect device (when required by Code) and the final connection to the outlet, device or equipment.
2. Branch Circuit Homerun: The power and equipment grounding conductors and associated raceways connecting the branch circuit overcurrent device(s) to an outlet box for electrical connection to a device or equipment or to a homerun

junction box for separation of the individual branch circuit conductors for routing to their respective loads when conductors for multiple branch circuits are combined in the same raceway.

3. Homerun Junction Box: A junction or outlet box in a branch circuit raceway system where all of the associated branch circuit conductors are combined into a single raceway for routing to the serving electrical distribution equipment. A Homerun Junction Box shall be located in an accessible location as close to the connected outlets, devices and equipment served by the associated branch circuits as reasonably possible.
4. Feeder Circuit: An electrical power circuit consisting of the overcurrent protection device, the power and equipment grounding conductors and the raceway system connecting components of the electrical distribution system.

1.3 REFERENCED STANDARDS

- A. ANSI/NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
- B. ANSI C80-1 - Rigid Steel Conduit - Zinc Coated (GRC).
- C. ANSI C80-3 - Electrical Metallic Tubing - Zinc Coated (EMT).
- D. ANSI C80-6 - Intermediate Metal Conduit - Zinc Coated (IMC).
- E. ANSI/SCTE 77 - Specification for Underground Enclosure Integrity.
- F. ASTM A 53/A 53M - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- G. BICSI TDMM - Telecommunications Distribution Methods Manual, latest edition.
- H. NEMA 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- I. NEMA FB 1 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
- J. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
- K. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- L. NEMA RN 1 - Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- M. NEMA TC 2 - Electrical Polyvinyl Chloride Conduit.
- N. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- O. NEMA TC 7 - Standard for High Density Polyethylene (HDPE) Raceway Conduit.
- P. NFPA 70 - National Electrical Code

- Q. TIA-569-B - Commercial Building Standard for Telecommunication Pathways and Spaces.
- R. UL 1 - Flexible Metal Conduit.
- S. UL 6 - Electrical Rigid Metallic Conduit - Steel.
- T. UL 360 - Liquid-Tight Flexible Steel Conduit.
- U. UL 514A - Metallic Outlet Boxes.
- V. UL 514B - Conduit, Tubing and Cable Fittings.
- W. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers.
- X. UL 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings.
- Y. UL 797 - Electrical Metallic Tubing - Steel.
- Z. UL 870 - Wireways, Auxiliary Gutters and Associated Fittings.
- AA. UL 2024 - Optical Fiber and Communication Cable Raceway.

1.4 SUBMITTALS

- A. Refer to Section 260500 "General Requirements for Electrical Systems" for additional requirements.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections and attachment details.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with NFPA 70 (NEC).
 - 2. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.6 DELIVERY, STORAGE & HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris and traffic.
- B. Protect PVC conduit from sunlight.
- C. Comply with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT

- A. Galvanized Rigid Steel Conduit (GRC): ANSI C80.1, UL 6; heavy wall galvanized steel.
- B. Intermediate Metal Conduit (IMC): ANSI C80.6; UL 1242; thinner wall galvanized steel.
- C. PVC Coated Rigid Steel Conduit: NEMA RN 1; with plastic protector caps.
- D. Fittings - Couplings, Conduit Bodies, Connectors and Bushings: NEMA FB 1, UL 514B, galvanized steel, threaded, connectors with double locknuts and steel insulating bushings, thermoplastic insulating bushings for conduits 2 inches and smaller, cast metal conduit bodies with cast aluminum cover and stainless steel screws and neoprene gaskets, PVC coated to match attached conduits.

2.2 ELECTRICAL METALLIC TUBING (EMT)

- A. ANSI C80.3, UL 797; galvanized steel tubing.
- B. Fittings - Couplings, Conduit Bodies and Connectors: NEMA FB 1, UL 514B: steel, compression-type connectors with insulated throat. Covers for conduit bodies shall be aluminum with stainless steel screws and neoprene gasket.

2.3 FLEXIBLE METAL CONDUIT (FMC)

- A. UL 1; interlocked steel.
- B. Fittings: NEMA FB 1, UL 514B, steel.

2.4 LIQUID-TIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. UL 360; interlocked steel with PVC jacket.
- B. Fittings: NEMA FB 1, UL 514B; steel.

2.5 RIGID NON-METALLIC CONDUIT (RNC)

- A. Non-metallic conduit shall be listed and labeled as defined in NFPA 70 (NEC) by a qualified listing agency and marked for the intended location and application.
- B. Type EPC-40 PVC minimum, electrical-grade, comply with NEMA TC 2 and UL 651. Type EPC-80 PVC where indicated.
- C. Rigid and Continuous HDPE: Schedule 40 minimum, Schedule 80 where indicated, comply with UL 651A.
- D. Where raceways are indicated on the drawings to be PVC, similarly-rated HDPE may be used as a direct substitution.

2.6 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, UL 514A: galvanized steel with stamped knockouts.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported, 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Cast-Metal Outlet Boxes: NEMA FB 1, cast or malleable iron, Type FD with gasketed cover and threaded hubs.
- C. Trim and Extension Rings: Same material and finish as box in which attached.

2.7 PULL & JUNCTION BOXES

- A. Indoor - Small Sheet Metal Pull and Junction Boxes: NEMA OS 1, UL 514A; galvanized steel.
- B. Indoor/Outdoor - Large Metal Pull and Junction Boxes: NEMA 250; steel, NEMA 1 or 3R per installed location, hinged or screw cover, manufacturer's standard enamel finish inside and out.
- C. Outdoor - Cast-Metal Outlet and Device Boxes: NEMA FB 1, cast or malleable iron, Type FD with gasketed cover with stainless steel screws.

2.8 METAL WIREWAYS

- A. NEMA 250, UL 80: sheet metal trough with hinged or removable cover.
- B. NEMA Type 1 enclosure where installed in dry indoor locations, NEMA 3R enclosure where installed outdoors or in damp or wet indoor locations, or NEMA 4X stainless steel enclosure for corrosive environments. No knockouts.
- C. Provide hinged cover for surface-mounted installations and removable cover for flush-mounted installations. Provide flanged and gasketed cover for all wet locations.
- D. Cross-sectional size and length as indicated or required for the installation requirements and per the box fill requirements of NFPA 70 (NEC).
- E. Finish: Manufacturer's standard enamel finish inside and out.

2.9 HANDHOLES & BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. For Medium-Voltage and Feeder Circuits, refer to Section 260543 Underground Duct and Raceways for Electrical Systems.
- B. General Requirements for Handholes and Boxes: Designed, identified, listed and labeled as defined in NFPA 70 (NEC) for intended location and application.

- C. Polymer-Concrete Handholes and Boxes: Molded of sand and aggregate, bound together with polymer resin and reinforced with steel, fiberglass or a combination of the two.
 - 1. Standard: Comply with SCTE 77.
 - 2. Configuration: Designed for flush burial with open bottom unless indicated otherwise.
 - 3. Cover: Weatherproof, secured by tamper-resistant locating devices and having structural load rating per the following:
 - (a) Installation in areas not subject to vehicular traffic: Tier 5 (5200 pounds) load rating.
 - (b) Installation in drives, parking lots, etc. or adjacent to such areas subject to occasional non-deliberate heavy-truck vehicular traffic: Tier 10 (10,400 pounds) load rating.
 - (c) Installation in streets or other areas with deliberate heavy-truck vehicular traffic: AASHTO H-20 (20,800 pounds) load rating.
 - 4. Basis of Design: Quazite Style PG or approved equal.
 - 5. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATIONS" as appropriate for systems installed within.

2.10 EXPANSION FITTINGS

- A. Malleable iron, hot dip galvanized allowing 2 inches of raceway movement.
- B. Basis of Design: OZ/Gedney AX Series or approved equal.

2.11 RACEWAY & SLEEVE PENETRATION SEALS

- A. Description: Modular sealing device, designed for field assembly to fill annular space between wall/floor penetration or sleeve and conduit or cable.
 - 1. Sealing Elements: EPDM, NBR or Silicon per application interlocking links shaped to fit surface of conduit or cable.
 - 2. Pressure Plates: Reinforced Nylon Polymer.
 - 3. Connecting Bolts/Nuts: Stainless Steel.
- B. Basis of Design - Thunderline Link-Seal Modular Seal or approved equal. Select Model appropriate for installed environment and probable contact elements.

2.12 RACEWAY SEALING FITTINGS

- A. Non-Hazardous Locations: Basis of Design - OZ/Gedney CSB Series or approved equal.
- B. Hazardous Locations: Basis of Design - OZ/Gedney EYA Series with sealing compound or approved equal.

- C. Field Applied Sealant Basis of Design - American Polywater Corporation FST Foam Duct Sealant or approved equal.

2.13 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E Grade B, Schedule 40, galvanized steel, plain ends with integral water stop.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. All power branch circuit and feeder circuit wiring and other Systems's wiring where specified shall be in metallic conduit unless specifically indicated otherwise on the drawings or herein specified.
- B. Outdoor Branch Circuit Installations: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC, IMC.
 - 2. Concealed Conduit, above ground: GRC, IMC.
 - 3. Underground Conduit: RNC, Type EPC-40 minimum, Type EPC-80 where indicated, direct buried or concrete encased as indicated.
 - 4. Connection to Vibrating Equipment: LFMC.
 - 5. Boxes and Enclosures, above ground: NEMA 250, NEMA 3R.
 - 6. Boxes and Enclosures, corrosive areas: NEMA 250, NEMA 4X.
- C. Indoor Branch Circuit Installations: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT, IMC or GRC.
 - 2. Exposed, Subject to Physical Damage: IMC, GRC.
 - 3. Concealed in Ceilings and Interior Walls/Partitions: EMT.
 - 4. Connection to Vibrating Equipment: FMC.
 - 5. Damp or Wet Locations: IMC, GRC.
 - 6. Size 1 1/4 inch or larger: IMC, GRC.
 - 7. Within Poured Concrete: IMC, GRC.
 - 8. Boxes and Enclosures: NEMA 250, NEMA 1 except NEMA 3R in damp or wet locations.
 - 9. Boxes and Enclosures, corrosive areas: NEMA 250, NEMA 4X.
- D. Feeder Circuit Installations: Apply raceway products as specified below unless otherwise indicated:
 - 1. Indoor: IMC, GRC.
 - 2. Exposed Conduit, outdoor: IMC, GRC.
 - 3. Concealed Conduit, above ground: IMC, GRC.

4. Underground Conduit: RNC Type EPC-40 with GRC bends and vertical risers, IMC, GRC.
 5. Under Slab Conduit: RNC Type EPC-40 with GRC bends and vertical risers, IMC, GRC.
 6. Within Poured Concrete: IMC, GRC.
 7. Concrete Encasement: Provide as indicated on drawings or herein specified.
- E. Minimum Raceway Size: 1/2 inch except branch circuit homerun conduits shall be minimum 3/4 inch.
- F. Homerun Raceways: Branch circuit homeruns shall not be combined in a raceway unless indicated on the Drawings to be routed in that manner. Provide the number of branch circuit homerun raceways as indicated on the Drawings unless otherwise directed by the Professional. Scheduled equipment electrical services shall have dedicated homerun branch circuits and raceways unless indicated otherwise on the Drawings.
- G. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. GRC and IMC: Threaded galvanized rigid steel unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Coated GRC: Use only fittings listed for use with this type of conduit with similar coatings. Patch and seal all joints, nicks and scrapes in coating after installing conduits and fittings. Use sealant recommended by manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 4. FMC: Use fittings listed for use with flexible conduit. Comply with NEMA FB 2.10.
 5. LFMC: Use fittings listed for use with liquid-tight flexible conduit that maintain liquid-tight rating.
- H. Where GRC conduit is direct-buried underground, it shall be coated prior to installation with polyvinyl, polyethylene or asphaltum coating. Coating shall cover entire underground conduit and associated fittings extend a minimum of 6 inches above finished grade.
- I. RNC may only be used where indicated on the drawings or herein specified.

3.2 COMMUNICATION RACEWAY APPLICATION

- A. Provide outlet boxes and serving raceway to accommodate devices indicated by symbols on the drawings and as herein specified.
- B. Minimum Communication Raceway Size: 3/4 inch unless otherwise indicated.
- C. Minimum Communication Outlet Box Size: 4 11/16 inches square by 2 1/8 inch depth unless specifically indicated otherwise or required to accommodate wall construction. Provide single-gang trim ring unless indicated otherwise or required for installed devices.

3.3 RACEWAY INSTALLATION

- A. Comply with the requirements of Section 260529 “Hangers and Supports for Electrical Systems” for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on the drawings or herein specified are stricter. Comply with NFPA 70 (NEC).
- C. Coordination: Raceway locations indicated on the drawings are approximate and representative unless dimensioned. Coordinate raceway installation with building elements, construction methods, other trades systems, etc.
- D. All conduits shall be routed concealed above ceilings within walls, partitions, floors, etc. unless specifically indicated on the drawings or herein specified otherwise. Route conduits parallel or perpendicular to building lines weather concealed or exposed.
- E. Size conduits as indicated on the drawings or where size is not indicated follow the requirements of NFPA 70 (NEC).
- F. Install raceways with the minimum number of bends in the shortest practical distance considering building construction and obstructions and other requirements of the drawings and this specification. Provide junction/pull boxes in accessible locations per NFPA 70 (NEC) to limit distance between conductor pull points to 100 feet or in conduit runs to limit bends between pull points to a total of 360 degrees.
- G. Do not route branch circuit, telecommunication or other Systems’ conduits within or under floor slab unless specifically indicated on the drawings to be installed in that manner, the adjacent building construction prohibits concealed overhead routing, or the nature of the connected device or outlet (i.e. floor box) requires this type of routing.
- H. Where conduits are indicated or required to be concealed in concrete floor slabs, conduits 1/2 inch through 1 inch may be installed within floor slabs. Conduits larger than 1 inch shall be installed under floor slab.
 - 1. Where conduits are indicated to be concealed in floor slab and thickness of floor slab is less than 4 inches, route all conduits below floor slab.
 - 2. Conduits shall be routed as required so as not to compromise the structural integrity of any concrete.
 - 3. Arrange conduits to cross building expansion joints at right angles with proper expansion fitting.
 - 4. Where conduits penetrate top of floor slab, provide PVC coated GRC up to a minimum of 2 inches above the top of the floor slab.
- I. Where the building floor slab and structure are elevated on pilings or other structural supports due to poor soil conditions, do not route branch circuit or feeder circuit raceways serving building outlets, devices or equipment in the earth. Raceways required to be routed under the floor slab shall be routed on the bottom of the elevated building structure.

1. Exceptions:
 - a. Underground electrical and communication service entrance raceways.
 - b. Raceways connecting equipment located away from the building on the adjacent site.
 - c. Raceways connecting the building to other adjacent buildings or facilities.
- J. Arrange conduit stub-ups so curved portion of bends are not visible above finished floor. Protect conduit stub-ups above floor slabs, finished grade, etc. from damage during and after construction. Provide temporary closures to prevent entrance of moisture, dirt and construction debris into conduits.
- K. Do not route raceways horizontally on roof unless specifically indicated on the drawings to be routed in that manner or with specific approval from the Professional. Do not install raceways or boxes on or within 2 inches of the bottom side of a metal roof deck.
- L. Turn-outs of concealed vertical "stub-up" raceways from outlet boxes shall be located to be above the finished ceiling line where ceilings exist or are provided. In open structure spaces with block or masonry walls, turn-outs shall occur above the bottom of the overhead structure.
- M. Do not route raceways in the air space between exterior wall assemblies and the brick veneer without specific approval from the Professional. Raceways may cross air spaces perpendicular to the associated wall.
- N. Make bends in raceways using large-radius preformed ells. Field bending shall be according to NFPA 70 (NEC) minimum radii requirements.
- O. Support conduits within 12 inches of enclosures in which attached, within 12 inches on both sides of any bend, and maximum distance between supports per NFPA 70 (NEC) based on conduit size and material.
- P. Vertical raceways runs 1 1/4 inch and larger passing through floors shall be supported at each floor with pipe riser clamps.
- Q. Keep raceways at least 6 inches away from parallel runs of flues, steam, hot-water pipes or other sources of heat.
- R. Complete raceway installation and ensure conduits are clear of all foreign debris prior to installing conductors.
- S. Provide a nylon pull cord with not less than 200 pounds tensile strength in all empty conduits. Leave a minimum of 12 inches of slack at each end. Cap raceways at both ends.

3.4 OUTLET BOX APPLICATION & INSTALLATION

- A. Provide outlet boxes and serving branch circuit to accommodate device or outlet provisions indicated by symbols on the drawings and in conformance with NFPA 70 (NEC) requirements for number and size of conductors, terminations and splices.
- B. Locations of all outlets and devices indicated on the drawings are approximate and representative unless dimensioned or specifically noted as to mounting height and location. See Architectural drawings, details or shop drawings for specific outlet locations. Any outlet box and associated raceways may be moved from the location indicated on the drawings in any direction up to a distance of 10 feet by direction of the Professional if so directed before the outlet and associated raceways have been installed at no additional cost.
- C. Mount outlet boxes at heights indicated on the Drawings and associated typical device mounting heights specified herein. Mounting heights may be adjusted slightly to permit cutting of masonry block to the top or bottom of the block course nearest the specified mounting height. Mounting heights shall be consistently cut above or below block coursing such that outlet boxes for similar devices will be the same height above the finished floor.
- D. Size outlet boxes at interior locations in accordance with NFPA 70 (NEC) and the following minimum outlet box requirements. Minimum conductor size used to determine power wiring box size shall be #12 AWG.
 - 1. Switch/Handy Box: Non-feed-through outlet applications with toggle switch or lighting control device, 5 conductors maximum.
 - 2. 4 inch octagon box, 1 1/2 inch depth: feed-through and non-feed-through outlet locations, 9 conductors maximum.
 - 3. 4 inch octagon box, 2 1/2 inch depth: feed-through and non-feed-through outlet locations, 13 conductors maximum.
 - 4. 4 inch square box, 1 1/2 inch depth: feed-through and non-feed-through outlet locations, pull and junction box locations, 9 conductors maximum.
 - 5. 4 inch square box, 2 1/8 inch depth: feed-through and non-feed-through outlet locations, pull and junction box locations, 13 conductors maximum.
 - 6. 4 11/16" square, 2 1/8 inch depth: feed-through and non-feed-through outlet locations, pull and junction box locations, 18 conductors maximum.
- E. Where a single outlet box is installed in a metal or wood stud wall, the box shall be attached to the studs using a metal mounting bracket with support leg to prevent movement of box in wall at unattached side. Where two or three outlet boxes are shown and/or intended to located adjacent to each other in a metal or wood stud wall, the boxes shall be attached to the studs using a common metal mounting bracket with bracket stabilizer leg to support the middle portion of the bracket.
- F. Provide single or double gang trim rings as required for outlets installed in hollow walls, square corner trim rings for outlet in tile walls. Mount outlet boxes with trim ring flush with finished surface. Face of outlet box or associated trim ring shall not be installed more than 1/4 inch behind finished face of wall.

- G. Outlet boxes installed in masonry wall shall be embedded in masonry grout so as to properly secure the box in place and prevent movement. Materials and labor required for this installation are the responsibility of the Division 26 Contractor.

3.5 PULL & JUNCTION BOX APPLICATION & INSTALLATION

- A. Provide pull or junction boxes as required by NFPA 70 (NEC), field conditions encountered and where indicated on the Drawings. Box locations shall be fully coordinated with the Professional where boxes are to be exposed or where installation affects architectural elements, structural construction or mechanical systems.
- B. Boxes sizes shall be as indicated on the Drawings; per NFPA 70 (NEC) for the conduit sizes, conductors and situation encountered; as herein specified; or as directed by the Professional.
- C. Wireways or gutters shall not be used unless specifically indicated on the Drawings or with specific approval from the Professional.
- D. All pull and junction boxes shall be labeled in accordance with Section 260553 "Identification for Electrical Systems" indicating system being served, branch circuit or feeder circuit identification, etc. Where installed in concealed locations (i.e. above accessible ceilings) or in unfinished areas, identification shall be made on outside of box cover. Where installed exposed in finished locations, identification shall be made on inside of box cover. Fire Alarm System pull and junction boxes where not exposed in a finished space shall have covers painted "red" in color.
- E. Close all unused knockout holes in junction/pull boxes and install proper cover. Junction/pull boxes install flush or exposed in finished spaces shall be installed with the same requirements as outlet boxes.

3.6 COMMUNICATION RACEWAY INSTALLATION

- A. Communication raceways shall comply with the applicable installation requirements of power raceways with the following additional requirements.
- B. Regulatory Requirements:
 - 1. Comply with TIA-569-B.
 - 2. Comply with NFPA 70 (NEC).
- C. Raceway routing shall follow most direct route possible to the designated termination point(s) within the constraints of this Section with no more than 180 degrees of bends between pull points or junction boxes. For raceway runs greater than 100 feet, provide junction box(es) sized per NFPA 70 (NEC) such that no conduit segment exceeds 100 feet.
- D. Conduit minimum bend radius:
 - 1. 6 times the internal diameter for conduits with internal diameters 2 inches or less.

2. 10 times the internal diameter for conduits with internal diameters greater than 2 inches.
- E. Communication outlet raceways serving outlets located in rooms with accessible ceilings shall have 4 inch square minimum in-line junction box surface-mounted directly above the outlet and above the accessible ceiling to allow access to the raceway from within the room.
- F. Conduit bends shall be smooth, even and free of kinks or other discontinuities that may have detrimental effects on pulling tension or cable integrity during or after installation.
- G. Provide insulating bushing on end of each raceway.
- H. Provide a nylon pull cord with not less than 200 pounds tensile strength in all empty conduits. Leave a minimum of 12 inches of slack at each end.

3.7 INSTALLATION OF UNDERGROUND CONDUIT

- A. Engage Utility Locating Service to locate, mark and identify all existing underground utilities in the area of work prior to any excavation.
- B. Direct-Buried Conduit:
 1. Excavate trench bottom to provide firm and uniform support for conduit.
 2. After installation of conduit, install select backfill, compact in 6 inch layers and mound for settlement. Start at tie-in point and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. After placing backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfill.
- C. Directional-Bored Conduits:
 1. Install using proper machinery using personnel fully-trained and experienced in the process and the associated machinery.
 2. Use continuous-length HDPE piping of indicated rating and size.
 3. Excavate significant area at raceway termination locations to install required conduit bends.
 4. After installation of conduit, install select backfill, compact in 6 inch layers and mound for settlement.
- D. Requirements:
 1. Conduit installed under structural concrete floor slabs and other installations with sub-grade compaction requirements of other Divisions of the specifications shall be installed to meet the minimum specified compaction requirements.

2. Provide manufactured long-radius elbows for stub-ups at poles, equipment and building entrances through floor slab unless otherwise indicated or prohibited by adjacent construction or existing conditions.
3. Use GRC conduit for all bends, vertical runs and exposed sections of RNC raceways.
4. Minimum Burial Depths:
 - a. Branch Circuit Raceway 1 1/4" Inch and Smaller: 18 inches to top below finished grade.
 - b. Branch Circuit Raceway 1 1/2 Inch and Larger: 24 inches to top below finished grade.
 - c. Feeder Circuit Raceway: 36 inches to top below finished grade.
 - d. Electrical Service Entrance Raceway: 36 inches to top below finished grade.
 - e. Communication Raceway: 30 inches to top below finished grade.
5. Underground Warning Tape: Provide per the requirements of Section 260553 "Identification for Electrical Systems".
 - a. Provide Warning Tape at all underground primary and secondary feeder circuits and branch circuits rated 100A and greater routed beyond the perimeter of the building's slab.

3.8 INSTALLATION OF UNDERGROUND HANDHOLES & BOXES

- A. Provide exterior in-grade handholes and boxes as indicated on the drawings, as required for the installation of the work per NFPA 70 (NEC) and as required by the serving Utility Companies.
- B. Size handholes and boxes as indicated or where size is not indicated comply with the requirements of NFPA 70 (NEC).
- C. Excavate as small an area as required to install box and associated raceways. Support units on a level bed of crushed stone or gravel, graded 1/2 inch sieve to #4 sieve, minimum 6 inches in depth and compacted to same density as adjacent undisturbed earth. Aggregate base shall cover entire box bottom and extend a minimum of 6 inches beyond the perimeter of the box on all sides. Backfill around box with select fill and compact to the same density as adjacent undisturbed earth.
- D. Elevation: In paved areas, set so cover is flush with finished surface. In other areas, set so cover is 1 inch above the finished grade.
- E. Conduits shall enter box from the bottom to prevent weakening the enclosure sides unless adjacent site conditions prevent such installation. When enclosure side walls must be field cut to accept raceways, follow manufacturer's written instructions and use recommended tools.
- F. Handholes and boxes larger than 24 inches in length or width shall be provided with 6 inch square concrete collar around the perimeter to provide added support.

3.9 APPLICATION & INSTALLATION OF FLEXIBLE CONDUIT

- A. Comply with NEMA RV 3.
- B. Application:
 - 1. Dry, Indoor Locations: FMC.
 - 2. Damp or Wet, Indoor Locations: LFMC.
 - 3. Outdoor Locations: LFMC.
 - 4. Connections to Vibrating Electrical Distribution Equipment: LFMC.
- C. Use a maximum of 72 inches of flexible conduit for connection to lighting luminaires, equipment subject to vibration, noise transmission or movement, and for transformers and motors.

3.10 APPLICATION & INSTALLATION OF EXPANSION FITTINGS

- A. Provide expansion fitting at all locations where conduits cross building or structural expansion joints, where conduits are mechanically connected to two separate structures, and where conduits pass above ground from interior to exterior of the building.
- B. Provide fittings that provide expansion and contraction for at least 0.0004 inches per foot of length of straight conduit run per degree F of temperature change.
- C. Install each expansion-joint fitting with position, mounting and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

3.11 APPLICATION & INSTALLATION OF RACEWAY SLEEVES

- A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- B. Use pipe sleeve unless penetration arrangement requires rectangular sleeved opening.
- C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

- G. Provide sleeve and raceway seals where penetrations are made in exterior walls, through on-grade slabs or below grade wall.

3.12 APPLICATION & INSTALLATION OF RACEWAY & SLEEVE PENETRATION SEALS

- A. Seal space outside of sleeves with grout for penetrations of concrete or masonry and approved joint compound for gypsum board assemblies.
- B. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- C. Above Ground, Exterior Wall Penetration: Seal penetration using sleeves and mechanical sleeve seals. Select sleeve size as required for annular clear space between raceway and sleeve for installing mechanical sleeve seals.
- D. Underground, Exterior Wall Penetration: Seal penetration using cast-iron pipe for sleeves and mechanical sleeve seals. Select sleeve size as required for annular clear space between raceway and sleeve for installing mechanical sleeve seals.
- E. Sleeve Seal Installation: Use type and number of sealing elements recommended by the manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve per the manufacturer's written instructions.
- F. Provide chrome- or nickel-plated escutcheons where raceways pass through walls, floors or ceilings and are exposed in finished public areas.

3.13 APPLICATION & INSTALLATION OF RACEWAY SEALING FITTINGS

- A. Provide listed watertight raceway seal-off fitting to prevent the passage of moisture and water vapor through raceway where:
 - 1. Raceway passes from interior to exterior of the building.
 - 2. Raceway passes from interior conditioned spaces to attic space of the building.
 - 3. Raceway passes between areas of different temperature (i.e. cold rooms, coolers, freezer, air handling systems, etc.).
- B. Provide field-applied raceway sealant to prevent the passage of moisture in all raceways that contain wiring, enter the building from below grade, and that terminate or have fittings located at an elevation that is below a horizontal line 24 inches above the adjacent exterior finished grade.
- C. Provide listed raceway seal-off fitting with sealing compound where raceways enter or leave hazardous locations as defined by NFPA 70 (NEC).

3.14 FIRESTOPPING

- A. Openings around electrical penetrations through smoke or fire rated wall, partition, floor or ceiling assemblies shall be smoke and/or fire stopped using an approved UL listed system designed for the materials encountered to maintain the smoke and/or fire rating of the assembly.
- B. Comply with Division 07 Section "Penetration Firestopping".
- C. All firestopping of penetrations in rated walls, partitions, floors or ceiling assemblies shall be performed by a certified Fire Proofing Contractor. The Division 26 Contractor shall be responsible for procuring and coordinating with the Fire Proofing Contractor to provide the required firestopping of all electrical penetrations in or through rated assemblies.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Identification products and methods.
 - 2. Warning labels and signs.
 - 3. Instruction signs and posted drawings.
 - 4. Miscellaneous identification products.

1.2 REFERENCED STANDARDS

- A. ANSI A13.1 - Scheme for the Identification of Piping Systems.
- B. ANSI C2 - National Electrical Safety Code.
- C. ANSI Z535.4 - National Standards for Product Safety Signs and Labels.
- D. 29 CFR - Labor, Part 1910 - Occupational Safety and Health Standards, Section 1910.145 - Specifications for Accident Prevention Signs and Tags.
- E. NFPA 70 - National Electrical Code.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A12.1 and ANSI/IEEE C2.
- B. Comply with NFPA 70 (NEC).
- C. Comply with 29 CFR 1910.145.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors and other features with Contract Documents, Shop Drawings, manufacturer's wiring diagrams, O&M Manuals and those required by codes, standards, 29 CFR 1910.145. Use consistent designations throughout the project.
- B. Coordinate installation of identifying devices with completion of covering, finishes and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors and manufacturer's nameplates, warning labels, instruction labels, etc..

- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY & CONDUCTOR 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.
- 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.
- C. Snap-Around Labels: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeves with diameter sized to suit diameter of raceway it identifies and to stay in place by gripping action when placed in position.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant, 1 or 2 inches wide, compounded for outdoor use.
- E. Marker Tapes: Vinyl or vinyl cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 UNDERGROUND WARNING TAPE

- A. 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.

2.3 WARNING LABELS & SIGNS

- A. Comply with NFPA 70 (NEC) 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 indicated otherwise.
- C. Engraved Plastic Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 square inches and 1/8 inch thick for larger signs.
 - 1. Engrave legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.

- D. Baked-Enamel Warning Signs for Interior Use: 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 inch X 10 inch.
- E. Metal-Backed, Butyrate Warning Signs for Exterior Use: Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396 inch galvanized-steel backing; with colors, legend and size required for application. 1/4 inch grommets in corners for mounting. Nominal size - 10 inch X 14 inch.

2.4 INSTRUCTION SIGNS & POST DRAWINGS

- A. Instruction Signs: Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 square inches and 1/8 inch thick for larger signs.
 - 1. Engrave legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.

2.5 EQUIPMENT IDENTIFICATION NAMEPLATES

- A. Engraved, Three-Layer, Laminated Acrylic or Melamine Nameplate: Punched or drilled for screw mounting. Minimum legend letter height shall be 3/8 inch unless indicated or specified herein otherwise.
- B. Stenciled Legend: Non-fading, waterproof ink or oil-based, alkyd enamel paint. Minimum legend letter height shall be 1 inch unless indicated or specified herein otherwise.
- C. Nameplates shall be colored-coded for each system as follows:
 - 1. Normal Power - white lettering on black field.
 - 2. Emergency/Life-Safety Power - black lettering on a red field.
 - 3. Legally Required/Critical Standby Power - black lettering on an orange field.
 - 4. Optional/Equipment Standby Power - black lettering on a yellow field.

2.6 WIRING DEVICE IDENTIFICATION

- A. Self-adhesive, clear label with 3/16 inch high printed black legend. Legend printed using thermal transfer.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS.

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 pound minimum.
 - 3. Temperature Range: -40 degrees F to 185 degrees F.
 - 4. Color: Black, except where used for color coding.

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Refer to the technical Sections of the Division 26 Specification for identification requirements for the specified material, equipment, components, etc.
- B. Warning Labels for Indoor Cabinets, Boxes and Enclosures: Comply with 29 CFR 1910.145 and NFPA 70 (NEC). Apply self-adhesive warning labels to exterior of door, cover or other access to equipment. Provide the following warning labels and those required by other codes, standards and regulatory agencies as a minimum.
 - 1. Equipment with Multiple Power Sources. Including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance per NFPA 70 (NEC): Apply to door or cover except flush-mounted equipment or equipment in finished spaces. Labeling for flush-mounted equipment or equipment in finished spaces shall be applied inside equipment door. Indicate clearance requirements per NFPA 70 (NEC) for voltage of equipment.
 - 3. Available Fault Current Labels: Install per NFPA 70 (NEC) for each piece of electrical service entrance equipment. Locate labels so they are visible to the personnel before examination, adjustment, servicing or maintenance of the equipment.
- C. Instruction Signs: Provide instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend printed in all capital letters of 12 point minimum font size where instructions are needed for system or equipment operation.
- D. Equipment Identification Nameplates: Each unit of electrical equipment shall be provided with a nameplate indicating the equipment designation consistent with the Drawings, connected voltage and phase, serving equipment designation and other specified information. Refer to the technical Sections of this Specification for the specified equipment for additional requirements.
 - 1. Nameplate: Engraved, laminated acrylic or melamine nameplate. Equipment designation legend using 1/2 inch high lettering, other legend information using 1/4 inch high lettering.

3.2 INSTALLATION

- A. Verify identity of each item before producing and installing identification products.
- B. 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 surface before application, using materials and methods recommended by manufacturer of identification device. Install parallel to equipment lines.
- E. Install non-adhesive signs and plastic nameplates parallel to equipment lines. Attach with screws and auxiliary hardware appropriate for the location and substrate. Locate to inside of door where equipment is flush-mounted in finished spaces.
- F. Post Drawings and Operating Instructions: Mount drawings and operating procedures on the wall immediately adjacent to the piece of equipment for which the instructions apply. If sufficient wall space is not available, mount directly to one of the sheet metal panels of the equipment as directed by the Professional.
- G. Warning Signs: Install warning signs where there is hazardous exposure or danger associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location. Mount permanently in an appropriate and effective location. Comply with ANSI A13.1 standard color and design.
- H. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side-by-side. Locate bands at changes in direction, at penetrations of wall and floors, at 50 foot maximum intervals. Locate bands on conductors and cables in raceway at all accessible locations.
- I. Underground Warning Tape: During backfilling of trenches install continuous underground warning tape directly above line at approximately 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 24 inches overall.

END OF SECTION

SECTION 262416 PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Branch-circuit panelboards.

1.2 DEFINITIONS

- A. EGP: Electronic-grade panelboard.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. K.A.I.C.: Kilo-ampere interrupt capacity.
- E. MCCB: Molded-case circuit breaker.
- F. PQM: Power quality meter.
- G. SCCR: Short circuit current rating.
- H. SPD: Surge protection device.

1.3 REFERENCED STANDARDS

- A. NECA 407 - Recommended Practice for Installing and Maintaining Panelboards
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volt Maximum)
- C. NEMA AB 1 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
- D. NEMA PB 1 - Panelboards
- E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- F. NFPA 70 - National Electrical Code
- G. UL 50 - Enclosures for Electrical Equipment

- H. UL 67 - Panelboards
- I. UL 486A-486B - Wire Connectors
- J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
- K. UL 869A - Reference Standard for Service Equipment

1.4 SUBMITTALS

- A. Refer to Section 260500 "General Requirements for Electrical Systems" for additional requirements.
- B. Product Data: For each type of panelboard.
 - 1. Submit catalog data showing specified features of standard product including materials, switching and overcurrent protection devices, SPDs, accessories and components indicated.
 - 2. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings:
 - 1. Submit for review prior to manufacturer. For each panelboard, include complete description, front view, dimensions, voltage, phase, wire, main bus ampacity, neutral bus rating, circuit breaker arrangement and sizes, short circuit current rating, and factory settings of protection devices.
 - 2. Indicate panelboard designation per Contract Drawings in minimum 10 point font on top right corner of each associated shop drawing sheet.

1.5 QUALITY ASSURANCE

- A. Obtain panelboards, overcurrent protection devices, components and accessories from one source and by single manufacturer.
- B. Regulatory Requirements:
 - 1. Comply with NFPA 70 (NEC).
 - 2. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.6 DELIVERY, STORAGE & HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris and traffic.
- B. Comply with NEMA PB 1.1 and manufacturer's written instructions.

- C. Do not deliver or install panelboard interiors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above panelboards is complete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Branch Circuit Panelboards

1. Basis of Design: ABB/General Electric Types AQ, AE or AD.
2. Equal in Square D Company, Siemens or Eaton.

B. Distribution Panelboards

1. Basis of Design: ABB/General Electric Spectra Series.
2. Equal in Square D Company, Siemens or Eaton.

2.2 BRANCH CIRCUIT PANELBOARDS

A. NEMA PB 1, UL 67.

B. Fabrication:

1. Commercial-grade, dead-front, factory assembled.
2. Incoming Feeder Lugs: Size and number per phase to match indicated feeder conductors size, material and number per phase.
3. Sub-feed or feed-thru lugs where indicated or required for multi-section panelboards.
4. Wiring terminals for field installed conductors: Pressure wire connectors except wire-binding screws for #10 AWG or smaller conductors.

C. Panelboard Buses:

1. Material: Copper.
2. Ampere rating as indicated.
3. Neutral Bus: Insulated, 100% of main bus rating unless indicated on Drawings to be 200% rated.
4. Ground Bus: Uninsulated, bonded to panelboard cabinet.
5. Terminals: One terminal per connected conductor.

D. Cabinet:

1. NEMA 250, UL 50.
2. NEMA Type 1 or Type 3R enclosure as indicated on Drawings or as required for installed environment.
3. Surface- or flush-mounted as indicated on Drawings.
4. Front: Door and trim with concealed hardware and cylinder-type lock and catch.
5. Boxes and fronts made of code-gauge steel.

6. Manufacturer standard gray enamel finish over prime coat.

E. Molded-Case Circuit Breakers:

1. NEMA AB 1, UL 489.
2. Bolt-On Type, labeled for 75 degree C copper and aluminum conductors.
3. Quick-make, quick-break, with thermal-magnetic trip.
4. Common internal trip on multi-pole breakers. Handle ties are not permitted.
5. Ampere rating and number of poles as scheduled.
6. Listed as Type SWD for lighting circuits.
7. Listed as Type HACR for air-conditioning equipment circuits.
8. Bussing, device mounting hardware and steel knockouts in dead front where space is indicated.
9. Tandem circuit breakers are not permitted.
10. Locks on trip handles with red device for circuits serving Fire Alarm Systems.
11. Shunt-trip device with 120V coil and auxiliary contacts where specified or indicated.
12. GFCI device, rated at 4-6 mA trip for protection of personnel where specified or indicated.
13. GFEP device, rated 30 mA trip to provide equipment protection where specified or indicated and for branch circuits serving heat tracing.

F. Short Circuit Current Rating:

1. Each panelboard with minimum short circuit current rating as indicated on the Drawings.
2. Fully-rated. Series-rated panelboards are not acceptable.

G. Surge Protection Device:

1. Device ratings and connection per requirements of Section 264313 "Surge Protection Devices" for the installed location of the panelboard in the electrical distribution system.
2. Provide where indicated on the Drawings or herein specified.
3. Provide for all panelboards connected to an Emergency Power System.

2.3 DISTRIBUTION PANELBOARDS

A. NEMA PB 1, UL 67.

B. Fabrication:

1. Commercial-grade, dead-front, factory assembled.
2. Incoming Feeder Lugs: Size and number per phase to match indicated feeder conductors size, material and number per phase.
3. Sub-feed or feed-thru lugs where indicated or required for multi-section panelboards.
4. Wiring terminals for field installed conductors: Pressure wire connectors except wire-binding screws for #10 AWG or smaller conductors.

C. Panelboard Buses:

1. Material: Copper.
2. Ampere rating as indicated.
3. Neutral Bus: Insulated, 100% of main bus rating unless indicated on Drawings to be 200% rated.
4. Ground Bus: Uninsulated, bonded to panelboard cabinet.
5. Terminals: One terminal per connected conductor.

D. Cabinet:

1. NEMA 250, UL 50.
2. NEMA Type 1 or Type 3R enclosure as indicated on Drawings or as required for installed environment.
3. Surface- or flush-mounted as indicated on the Drawings.
4. Front: Door and trim with concealed hardware and cylinder-type lock and catch.
5. Boxes and fronts made of code-gauge steel.
6. Manufacturer standard gray enamel finish over prime coat.

E. Molded-Case Circuit Breakers:

1. NEMA AB 1, UL 489.
2. Bolt-On or I-Line Type, labeled for 75 degree C copper and aluminum conductors.
3. Quick-make, quick-break, with thermal-magnetic trip.
4. Common internal trip on multi-pole breakers. Handle ties are not permitted.
5. Ampere rating and number of poles as scheduled.
6. Listed as Type HACR for air-conditioning equipment circuits.
7. Bussing, device mounting hardware and steel knockouts in dead front where space is indicated.
8. Shunt-trip device with 120V coil and auxiliary contacts where specified or indicated.

F. Short Circuit Current Rating:

1. Each panelboard with minimum short circuit current rating as indicated on the Drawings.
2. Fully-rated. Series-rated panelboards are not acceptable.

G. Surge Protection Device:

1. Device ratings and connection per requirements of Section 264313 "Surge Protection Devices" for the installed location of the panelboard in the electrical distribution system.
2. Provide where indicated on the Drawings or herein specified.

2.4 SERVICE ENTRANCE

A. UL 869A.

- B. Panelboards labeled as suitable for use as service entrance equipment where applicable and shall include connection for bonding and grounding neutral conductor.

PART 3 - EXECUTION

3.1 COORDINATION WITH MANUFACTURER

- A. Instruct manufacturer about the requirement and location for additional gutter space when required for wiring or specified accessories.
- B. Instruct manufacturer about the location of the main lugs or main circuit breaker location based on incoming feeder entrance location.
- C. Instruct manufacturer to provide multiple lugs where feeder circuit utilizes paralleled conductors and where sub-feed or feed-thru lugs are indicated or required.

3.2 INSTALLATION

- A. Provide panelboards complete with feeder circuit, circuit breakers and branch circuits as scheduled and indicated on the Drawings.
- B. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- C. Panelboard Mounting:
 - 1. Fasten panelboards firmly to walls and structural surfaces ensuring they are permanently and mechanically anchored.
 - 2. Anchor and fasten panelboards and their supports to building structural elements by methods described in Section 260529 "Hangers and Supports for Electrical Systems."
 - 3. Install two rows minimum of steel slotted channel with a minimum of 4 attachment points for each panelboard section.
 - 4. When not directly located on structural wall, provide support frame of steel slotted channel anchored to floor and ceiling structure.
 - 5. Install such that top circuit breaker handle is a maximum of 6 foot 6 inches above the finished floor or working platform with handle in its highest position.
 - 6. Install so as to maintain minimum working space clearance in all directions and dedicated electrical equipment spaces per NFPA 70 (NEC).
 - 7. Flammable surfaces used for mounting panelboards shall be painted with 2 coats of flame resistant paint.
- D. Tighten electrical connectors and terminals according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. Install filler plates in unused spaces.
- F. Leave all spare circuit breakers in the OFF position.

- G. At all flush-mounted branch circuit panelboards, install four 3/4 inch spare conduits stubbed into ceiling space or above the bottom of the overhead structural steel
- H. At flush-mounted distribution panelboards, provide spare conduit(s) routed to accessible ceiling location for each spare circuit breaker provided properly sized for a four conductor feeder and associated grounding conductor of the same ampere rating as the associated spare circuit breaker
- I. Verify that the egress doors to electrical room(s) containing panelboards with ampere ratings of 800A or greater open in the direction of egress and are equipped with listed panic hardware.
 - 1. The Division 26 Contractor is responsible for coordinating the electrical space door and egress requirements with the General Contractor and providing the panic hardware if not provided with the door(s) supplied.

3.3 CONNECTIONS

- A. Ground panelboards according to Section 260526 "Grounding and Bonding for Electrical Systems.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors".
- C. Connect SPD according to Section 264313 "Surge Protection Devices".

3.4 IDENTIFICATION

- A. Provide engraved plastic nameplates per Section 260553 "Identification for Electrical Systems". Nameplate legend shall include panelboard designation per the Drawings; voltage, phase and wire; and "Fed From:" source designation.
 - 1. Attach to face of trim for panelboards located in non-public or non-finished spaces and inside door for panelboards located in public or finish spaces.
 - 2. Attach to panelboard using small metal screws or rivets.
- B. Branch Circuit Panelboards: Provide typewritten directory with transparent plastic cover indicating all connected circuit loads and install in directory frame mounted inside panelboard door. Directory shall also include listing of panelboard designation, voltage, phase, wire and "Fed From:" source.
- C. Distribution Panelboards: Provide self-adhesive, engraved plastic nameplates at each circuit breaker indicating load served per the load designations indicated in the Contract Documents.
- D. Circuit Numbering: Branch circuit panelboard circuits shall be numbered in sequence vertically down the left side then vertically down the right side and all circuits shall be arranged in the panelboard exactly as they are shown on the Drawings. Numbering to be consecutive across double and triple section panelboards.

- E. Label all spare circuit breakers as SPARE.

3.5 SPECIAL CONDITIONS & ACCESSORIES

- A. Verify that the egress doors to electrical room(s) containing panelboards with ampere ratings of 800A or greater shall open in the direction of egress and shall be equipped with panic hardware. The Division 26 Contractor is responsible for coordinating the door requirements with the General Contractor and providing the panic hardware if not provided with the door(s) supplied.
- B. Panelboards served from the secondary side of a dry-type transformer constituting a separately derived system per NFPA 70 (NEC) shall be provided with a main circuit breaker sized as indicated on the Drawings or per the NFPA 70 (NEC) if size not indicated.
- C. Branch circuit breakers serving outlets and equipment located under a kitchen exhaust hood equipped with a fire suppression system shall be the shunt-trip type.
- D. Branch circuit breakers serving elevator motors shall be the shunt-trip type with auxiliary contacts.

3.6 FIELD QUALITY CONTROL

- A. Inspect for physical damage, proper alignment, anchorage and grounding.
- B. Check phase-to-phase and phase-to-ground insulation resistance levels prior to energizing panelboard.
- C. Check panelboards for electrical continuity of circuits and short-circuits prior to energizing panelboard.

3.7 ADJUSTING

- A. Adjust fronts, covers, hinges, doors and locks for proper alignment and operation. Adjust doors and locks for smooth operation.

3.8 CLEANING & TOUCH-UP

- A. Clean panelboard interiors and exteriors. Remove paint splatters and other spills. Completely remove dirt and debris from panelboard interior.
- B. Touch-up chips, scratches or marred finishes to match original finish using manufacturer-supplied paint kit.

END OF SECTION

**SECTION 262726
WIRING DEVICES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General-Use Snap (Toggle) Switches.
 - 2. Power Receptacles.
 - 3. Device Covers and Plates.

1.2 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEQ: Ground-fault equipment protection.
- D. Pigtail: Short wiring lead used to connect a device to a branch circuit conductor.
- E. SPD: Surge protection device.

1.3 REFERENCED STANDARDS

- A. ANSI/NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
- B. IEEE C62.41.2 - Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.
- C. IEEE C62.45 - Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits.
- D. NFPA 70 - National Electrical Code.
- E. NFPA 99 - Health Care Facilities Code.
- F. NEMA FB 11 - Plugs, Receptacles, and Connector of the Pin and Sleeve Type for Hazardous Locations.
- G. NEMA WD-1 - General Color Requirements for Wiring Devices.
- H. NEMA WD-6 - Wiring Devices - Dimensional Requirements.
- I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volt Maximum).

- J. UL 20 - General-Use Snap Switches.
- K. UL 498 - Attachment Plugs and Receptacles.
- L. UL 943 - Ground-Fault Circuit-Interrupters.
- M. UL 1010 - Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
- N. UL 1436 - Outlet Circuit Testers and Similar Indicating Devices.
- O. UL 1449 - Standard for Surge Protection Devices.
- P. UL 1472 - Solid State Dimming Controls.
- Q. UL 1917 - Solid-State Fan Speed Controls.

1.4 SUBMITTALS

- A. Refer to Section 260500 "General Requirements for Electrical Systems" for additional requirements.
- B. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

- A. Obtain wiring devices from one source and by single manufacturer.
- B. Regulatory Requirements:
 - 1. Comply with NFPA 70 (NEC) for components and installation.
 - 2. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.6 DELIVERY, STORAGE & HANDLING

- A. Store in clean, dry space.
- B. Maintain factory unopened packaging until ready for installation.

PART 2 - PRODUCTS

2.1 GENERAL-USE (TOGGLE) SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated
 - 2. Legrand/Pass & Seymour
 - 3. Cooper Wiring Devices

4. Leviton Manufacturing Company
- B. Comply with NEMA WD-1 and UL 20.
- C. Switches: Heavy-duty, specification-grade; back and side wired; flush or surface mounting; for connection to copper conductors.
Body and Handle: Thermoplastic with toggle handle
1. Ratings: 120-277 Volts AC, 20 A minimum.
 2. Single pole, double pole as indicated.
 3. Three- or Four-way where indicated.
 4. Key-operated where indicated.

2.2 RECEPTACLES

- A. Manufacturers:
1. Hubbell Incorporated
 2. Legrand/Pass & Seymour
 3. Cooper Wiring Devices
 4. Leviton Manufacturing Company
- B. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, and UL 498.
- C. Receptacle: Heavy-duty, specification-grade; back and side wired; flush or surface mounting; straight-blade; 2 pole, 3 wire grounding; for connection to copper conductors.
Body: Thermoplastic.
1. Ratings: 125 Volts AC, 20 A minimum.
 2. Single, duplex or double-duplex as indicated.
 3. Special features and types and combination of types as indicated on the Drawings.
 4. GFCI Type:
 - a. Additional compliance with UL 943 Class A.
 - b. Leakage current trip level: 4 to 6 mA.
 - c. Trip Time: 0.025 seconds nominal.
 - d. Test and reset buttons.
 - e. Reverse line-load function to prevent device from functioning if wired incorrectly.
 - f. Self-test feature to prevent device from delivering power if GFCI protection is lost.
 - g. Indicator Light: Illuminated when device is tripped.
 5. Tamper Resistant (TR) Type:
 - a. Requires insertion of object in both left and right contacts to energize.

6. Twist-Locking Type:
 - a. NEMA WD-6 configuration as indicated on Drawings.
7. Hospital-Grade:
 - a. Listed and labeled "Hospital Grade" with UL green dot symbol on face of device.
 - b. Provide in all patient-care rooms and spaces and as indicated on the Drawings in health care facilities governed by NFPA 99.
8. Switched Receptacles for Automatic Control:
 - a. NFPA 70 (NEC) required marking on device face indicating outlets controlled.
9. USB Charging Type:
 - a. Duplex receptacle with duplex, Type-A, 5V, 5A USB charging ports.
10. Isolated-Ground Type:
 - a. Insulation-barrier to isolate device from metallic raceway system.
 - b. Isolated-ground "triangle" symbol on face of device.
11. Surge-Protection Type:
 - a. Integral surge protection within device.
 - b. SPD indication symbol on face of device.

D. Special Purpose Receptacles: Heavy-duty, specification-grade device, rated for voltage and amperage with NEMA configuration as indicated on the Drawings.

E. Hazardous Location Receptacles: Comply with NEMA FB 11 and UL 1010.

2.3 CORD & PLUG DROPS

- A. Receptacle: Voltage and ampere rating and NEMA configuration as indicated on the drawings. Nylon body with integral cable-clamping jaws.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW jacket. Phase and neutral conductors as required with insulated green equipment grounding conductor.
- C. Provide properly-sized kellems cable grips at each end of cord.

2.4 DEVICE COVERS & PLATES

- A. Plates: Single and combination types to match corresponding wiring devices.

1. Material for Finished Spaces: stainless steel, satin finish, 0.035 inch thick.
 2. Material for Unfinished Spaces: galvanized steel.
- B. Weatherproof Covers: NEMA 250 complying with Type 3R, die-cast aluminum, weather-resistant.
1. Covered Exterior Spaces: Spring-loaded and gasketed snap-shut outlet covers.
 2. Uncovered Exterior Spaces: Die-cast aluminum "In-Use" hinged cover with exit holes in bottom for wiring and locking provisions.
- C. Tamper Resistant (TR): Slide cover over receptacle.

2.5 FINISHES

- A. Color of Switch Handles and Receptacle Face: Gray except as listed below or manufacturer's standard color as selected by the Professional. Verify device color with the Professional prior to ordering equipment.
1. Switches and Receptacles connected to a Standby or Emergency Power System: Red; plate shall be engraved with red lettering "EMERGENCY".
 - a. Where the entire electrical system of a facility is connected to a Standby or Emergency Power System only the devices connected to the Life-Safety Branch of the System shall be Red in color.
 2. Receptacles connected to UPS System: Orange

PART 3 - EXECUTION

3.1 COORDINATION

- A. Verify location of wiring devices with Architectural interior elevation drawings, furniture drawings and millwork/casework drawings prior to rough-in.
- B. Special Purpose Receptacles: Coordinate final selection of NEMA configuration of device with configuration of plug on utilization equipment.
- C. Receptacle for Owner-Furnished Equipment and Equipment Furnished under other Divisions of the Specification: Verify and coordinate final selection of NEMA configuration of device with configuration of plug on utilization equipment.
- D. Coordination with Other Trades:
1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers guided by riding against outside edge of box.

2. Keep outlets free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint and other foreign material that may contaminate the raceway system, conductors and cables.
3. Install device boxes in brick or block walls so that the device cover plate does not cross a masonry joint unless the joint is troweled flush with the face of the wall.
4. Verify wall openings are neatly cut around outlet boxes in a manner that they will be completely covered by wall plates. Notify General Contractor of openings that require correction. Do not use oversize plates.

3.2 PREPARATION

- A. Verify that outlet boxes are firmly attached and secured to prevent movement prior to installing wiring and device.
- B. Clean all debris from outlet boxes.

3.3 DEVICE APPLICATION

- A. Provide and connect wiring devices as specified herein and as indicated on the Drawings by symbols with associated serving branch circuits.
- B. GFCI Receptacles: Provide GFCI type device as indicated on the Drawings and per the following:
 1. Within 6 feet of a counter-top or floor-mounted sink, bathtub or shower stall.
 2. Toilets/Restrooms.
 3. Kitchens.
 4. Indoor damp or wet locations.
 5. Locker rooms with showering facilities.
 6. Garages including vehicle maintenance facilities.
 7. Crawl spaces and unfinished areas of basements.
 8. Laundry areas.
 9. Electric drinking fountains.
 10. Elevator machine rooms.
- C. Weatherproof GFCI Receptacles: Provide weatherproof GFCI receptacles with proper cover per installed location as indicated on the Drawings and per the following:
 1. Outdoors.
 2. Rooftops within 25 feet of roof-top mechanical equipment without integral convenience outlet.
 3. Elevator pits.
- D. Tamper-Resistant Receptacles: Provide tamper-resistant type device as indicated on the Drawings and per the following:
 1. Dwelling Units including apartments, condominiums, etc.
 2. Guest Rooms and Guest Suites of hotels, motels and their commons spaces.

3. Child Care Facilities.
 4. Preschools and Educational Facilities.
 5. Business offices, corridors, waiting rooms and the like in Clinics, Medical and Dental Offices, and Outpatient Facilities.
 6. Assembly Occupancies: Places of Awaiting Transportation, Gymnasiums, Skating Rinks and Auditoriums.
 7. Dormitory Units.
 8. Assisted Living Facilities.
- E. AFCI protected Receptacles: Provide AFCI type circuit breaker for protection of wiring device branch circuits as indicated on the Drawings and per the following:
1. Dwelling Units including apartments, condominiums, etc.
 2. Dormitory Units.
 3. Guest Rooms, Guest Suites and Patient Sleeping Rooms in Nursing Homes and Limited-Care Facilities.

3.4 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise specified, scheduled or indicated. Indicated mounting heights shall be to center of device.
- B. Conductors:
1. Do not strip insulation from conductors until just before they are splice or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking solid wire or cutting strands of stranded wire.
 3. Length of free conductors at outlets for devices shall meet provisions of NFPA 70 (NEC) without pigtails.
 4. Do not use stranded conductors for termination to devices unless crimp-on fork terminals are used for terminations.
- C. Device Installation:
1. Keep device in its manufacturer's package or otherwise protected until it is installed.
 2. Do not remove surface protection, such as plastic film and smudge covers until last possible moment.
 3. Devices shall be connected to serving branch circuit using pigtails a minimum of 6 inches in length. Do not connect receptacles in a feed-through manner.
 4. Terminate conductors for all devices using side terminal binding-head screw terminals. Wrap solid conductor tightly clockwise around terminal screw.
 5. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 6. When conductor larger than #12 AWG are installed for 15A or 20A branch circuits, splice #12 AWG pigtails to branch circuit for device connections.
 7. Tighten unused terminal screws on the device.

8. When mounting devices in metal boxes, remove fiber or plastic washers to hold device mounting screws in yoke, allowing metal-to-metal contact.
9. Install devices plumb, level with finished surfaces and free from blemishes.
10. Install lighting switches vertically on latch side of door. Where adequate space for switch installation does not exist on latch side of door, mount switch on hinge side of door so switch is not located behind door in open position. First switch of single or ganged switch bank shall be mounted within 12 inches of door frame or edge of door.
11. Install devices above counters, 4 inches to centerline of the device above the countertop or backsplash where present. Install all devices at same height above any one counter or fixed cabinet.
12. Group adjacent switches under single, multigang wall plate.
13. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conduct. Ground per the requirements in Section 260526 "Grounding and Bonding for Electrical Systems".

D. Device Mounting Heights:

1. Switches: 48 inches to center above finished floor unless indicated otherwise.
2. Receptacles: 18 inches to center above finished floor unless indicated otherwise.
3. Receptacles at Counter Top: 4 inches to center above top of counter or backsplash unless indicated otherwise.
4. Receptacles in Shops/Garages: 48 inches to center above finished floor unless indicated otherwise.
5. Equipment Receptacles: Height and location as directed by equipment provider for proper equipment connection with supplied equipment power cord and for concealment behind equipment in public spaces (i.e. electric drinking fountains).

E. Device Installation Orientations:

1. Install ground pin of vertically-mounted receptacles up, and on horizontally-mounted receptacles to the right.
2. Install switches with handle operating vertically with "ON" position up.
3. Unless otherwise indicated or where adequate space is not available due to adjacent construction, mount devices flush with long dimension vertical.

F. Device Cover Plates:

1. Provide cover plate on all outlet boxes whether or not a device is installed. Provide blank plate on empty, spare or future outlet boxes.
2. Plates shall be properly secured to outlet box with all four corners in contact with wall finish and oriented parallel/perpendicular to adjacent building surfaces.
3. Plates shall not be installed such that corners are protruding from edge of outlet box or wall surface creating a snagging or sharp edge condition.

3.5 IDENTIFICATION

- A. Provide self-adhesive clear label with black lettering on the face of all receptacles indicating serving panelboard and branch circuit number.

- B. Receptacles connected to standby power system shall have engrave plates as herein specified.

3.6 FIELD QUALITY CONTROL

- A. Inspect wiring devices for defects and replace as required.
- B. Operate wall switches with connected circuits energized and verify proper operation and equipment controlled.
- C. Perform the following tests:
 - 1. Test all receptacles with receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed neutral and ground reversed. Rewire receptacles with faults and retest.
 - 2. Test each GFCI receptacle for proper operation. Perform testing with an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. Test for compliance with specified functions.
- D. Adjust devices and associated plates to be flush with wall finish, level and plumb.

3.7 CLEANING

- A. Clean devices and cover plates after painting is complete. Replace stained or improperly painted devices and cover plates.
- B. Clean all devices and plates of dust, dirt, stains, spills and construction debris.

END OF SECTION

**SECTION 262816
ENCLOSED SWITCHES & CIRCUIT BREAKERS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible and non-fusible disconnect switches.
2. Circuit breakers in individual enclosures.
3. Toggle-switch disconnects.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. K.A.I.C.: Kilo-ampere interrupt capacity.
- D. MCCB: Molded-case circuit breaker.
- E. MMS: Manual motor switch. For the purpose of the Division 26 Specifications, a manual motor switch shall be a toggle-switch disconnect with lockout bracket.
- F. SCCR: Short circuit current rating.
- G. SPDT: Single-pole, double throw.

1.3 REFERENCED STANDARDS

- A. ANSI/NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting.
- B. NEMA AB 1 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
- C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- D. NFPA 70 - National Electrical Code.
- E. UL 98 - Enclosed and Dead Front Switches.
- F. UL 486A - 486B - Wire Connectors.
- G. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.

H. UL 869A - Reference Standard for Service Equipment.

1.4 SUBMITTALS

A. Refer to Section 260500 "General Requirements for Electrical Systems" for additional requirements.

B. Product Data: For each type and rating of switch or enclosed circuit breaker.

1. Submit catalog cut sheet of manufacturer's standard product indicating voltage, amperage, HP ratings, enclosure type, dimensions, fuse clip features, terminal lugs and all accessories including interlock devices, short circuit current ampere rating and factory settings of individual protective devices.

1.5 QUALITY ASSURANCE

A. Obtain disconnect switches and enclosed circuit breakers and accessories from one source and by single manufacturer.

B. Regulatory Requirements:

1. Comply with NFPA 70 (NEC).
2. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.6 DELIVERY, STORAGE & HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris and traffic.

B. Comply with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Disconnect Switches

1. Basis of Design: ABB/General Electric.
2. Equal in Square D Company, Siemens or Eaton.

B. Enclosed Circuit Breakers

1. Basis of Design: ABB/General Electric.
2. Equal in Square D Company, Siemens or Eaton.

2.2 DISCONNECT SWITCHES

- A. NEMA KS 1, UL 98.
- B. Load interrupter enclosed knife switch, heavy-duty type.
- C. Fusible or non-fusible type as indicated on the Drawings or specified herein.
- D. Switch Interiors:
 - 1. Switch blades that are visible in "OFF" position when enclosure door is open.
 - 2. Plated current carrying parts.
 - 3. Removable arc suppressors to permit easy access to line-side lugs.
- E. Switch Mechanism:
 - 1. Quick-make, quick-break with visible blades and externally operable handle.
 - 2. Lockable only in "OFF" position.
 - 3. Dual cover interlock to prevent unauthorized opening of enclosure door when operating handle is in the "ON" position and to prevent closing of switch mechanism with enclosure door open.
 - 4. Defeater mechanism to bypass interlock.
 - 5. Operating handle integral part of enclosure.
 - 6. Handle to physically indicate "ON" and "OFF" position.
- F. Ratings:
 - 1. Ampere rating as indicated on Drawings.
 - 2. Horsepower rated.
- G. Fusible Switches:
 - 1. Rejection clips for Class R fuses.
 - 2. Provisions for Class J or Class L fuses as applicable.
 - 3. Where indicated to be fused, provide current-limiting, dual-element, time-delay fuses of indicated ampere rating.
 - a. Basis of Design: Bussman Fusetron Series or approved equal.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. NEMA AB 1, UL 489.
- B. Enclosed molded-case circuit breakers:
 - 1. Tripped indication clearly shown on breaker handle taking position between "ON" and "OFF" positions.
 - 2. Thermal-magnetic trip unless indicated otherwise.

- C. Breaker Mechanism:
 - 1. Quick-make, quick-break.
- D. Ratings:
 - 1. Ampacity and number of poles as indicated on the Drawings.
 - 2. Breaker ampere rating shall be visible with enclosure door open and all interior covers in place.
 - 3. Listed as Type HACR for air conditioning equipment circuits.
 - 4. Listed as Type SWD for lighting circuits.

2.4 TOGGLE-SWITCH DISCONNECT

- A. Comply with the requirements of Section 262726 "Wiring Devices" for device.
- B. Toggle-switch ratings:
 - 1. Ampere Rating: As indicated, minimum 20 amperes.
 - 2. Voltage Rating: 120/277V.
- C. Enclosure: Standard 4" square box with galvanized surface cover with permanently attached lockout bracket.
 - 1. Lockout Bracket: Equal to Leviton LKOUT-40, stainless steel construction, tamper-resistant attachment screws.
- D. Use Limitations:
 - 1. Where indicated on the Drawings
 - 2. Motors: Rated 1 HP or less, 250 volt maximum, single or three phase.
 - 3. Equipment: Rated 16 full-load amperes or less, 250 volt maximum, single or three phase.
 - 4. Indoor, dry location use only.
 - 5. Do not use where disconnect switch is specified unless directed by the Professional.

2.5 LUGS

- A. Front removable lugs.
- B. Labeled for 75 degree C copper and aluminum conductors.
- C. Multiple lugs to match indicated number of conductors per phase.
- D. Termination of field installed conductors: Pressure wire connectors, except wire-binding screws for #10 AWG or smaller conductors.

2.6 ACCESSORIES

- A. Equipment ground kit.
- B. Solid Neutral Assembly, where required.
- C. Auxiliary Contacts, NO/NC, where indicated or required.
 - 1. Elevators: Switches serving elevator motor and control circuits shall be provided with auxiliary contacts.
- D. Shunt-trip circuit breaker, 120 volt coil, where indicated or required.

2.7 ENCLOSURES

- A. NEMA KS 1, NEMA AB 1, UL 98, UL 489, as applicable.
- B. NEMA Type 1, NEMA Type 3R, NEMA Type 4X stainless-steel as required by NFPA 70 (NEC) for the installed environment and the following:
 - 1. Indoor, dry locations: NEMA Type 1
 - 2. Indoor, wet locations: NEMA Type 3R
 - 3. Indoor, corrosive locations: NEMA Type 4X
 - 4. Indoor, commercial kitchen areas: NEMA Type 4X
 - 5. Outdoor, covered or uncovered locations: NEMA 3R
 - 6. Outdoor, near cooling towers: NEMA 4X
- C. Code-gauge galvanized steel with manufacturer's standard gray enamel finish over prime coat. All NEMA Type 4X enclosures shall be stainless steel.
- D. Surface-mounted. Flush-mounted circuit breaker enclosure where indicated.

2.8 SERVICE ENTRANCE

- A. UL 869A.
- B. Switches and circuit breakers indicated to be used for electrical service entrance equipment shall be labeled for this application and shall be provided with solid neutral assembly and equipment ground bar and shall include connection for bonding and grounding neutral conductor.

2.9 SHORT CIRCUIT CURRENT RATING

- A. Each circuit breaker shall have minimum K.A.I.C. rating as indicated on the drawings. If rating not indicated, use same rating as serving electrical distribution equipment.

PART 3 - EXECUTION

3.1 EXAMINATION & COORDINATION

- A. Examine areas and surfaces to receive disconnect switches, enclosed circuit breakers and manual motor switches for compliance with requirements, installation tolerances and other conditions affecting performance.
- B. Verify that space indicated for mounting devices meets access and working space clearances required by NFPA 70 (NEC).
 - 1. Coordinate mounting location of devices with the work of other trades to ensure accessibility and working clearances are maintained after installation of other work.

3.2 INSTALLATION

- A. Provide and connect enclosed circuit breakers and switches as specified herein and as indicated on the drawings by symbols and schedules.
- B. Install in accordance with ANSI/NECA 1.
- C. Install disconnect switches, enclosed circuit breakers and toggle-switch disconnects level and plumb in accordance with manufacturer's written instructions.
- D. Mounting of Disconnect Switches and Enclosed Circuit Breakers:
 - 1. Fasten devices firmly to walls and structural surfaces, ensuring they are permanently and mechanically anchored.
 - 2. Comply with Section 260529 "Hangers and Supports for Electrical Systems".
 - 3. Install two rows of steel slotted channel with a minimum of four attachment points for each device. Gang multiple devices mounted at same location on common mounting channel where possible.
 - 4. Where suitable mounting substrate is not available or properly located, provide support frame of steel slotted channel anchored to floor and ceiling structure.
- E. Do not support disconnect switches or enclosed circuit breakers by raceway system.
- F. Install disconnect switch, enclosed circuit breaker and toggle-switch disconnect with centerline of operating handle 54 inches above finished floor or work platform where possible. Adjust mounting height as required for field conditions maintaining NFPA 70 (NEC) accessibility, clearance and operation requirements.
- G. Tighten electrical connectors and terminals according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- H. Install proper fuses in fusible switches.

3.3 IDENTIFICATION

- A. Provide engraved plastic nameplates per Section 260553 "Identification for Electrical Systems". Attach nameplate to exterior of enclosure of surface-mounted switches and enclosed circuit breakers using small stainless steel screws or rivets. Do not use self-adhesive backing as sole fastening means.
- B. Switch or enclosed circuit breaker nameplate shall include: Equipment Designation for connected equipment, circuit voltage and phase, branch circuit designation (panelboard name and circuit number).

3.4 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems".
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors".

3.5 FIELD QUALITY CONTROL

- A. Inspect for physical damage, proper alignment, anchorage and grounding.
- B. Check phase-to-phase and phase-to-ground insulation resistance levels prior to energizing equipment.
- C. Check for electrical continuity of circuits and short-circuits prior to energizing.

3.6 ADJUSTING

- A. Adjust fronts, covers, hinges, doors and locks for proper alignment and operation. Adjust doors and locks for smooth operation.

3.7 CLEANING & TOUCH-UP

- A. Clean interiors and exteriors. Remove paint splatters and other spills. Completely remove dirt and debris from enclosure interior.
- B. Touch-up chips, scratches or marred finishes to match original finish using manufacturer-supplied paint kit.

END OF SECTION