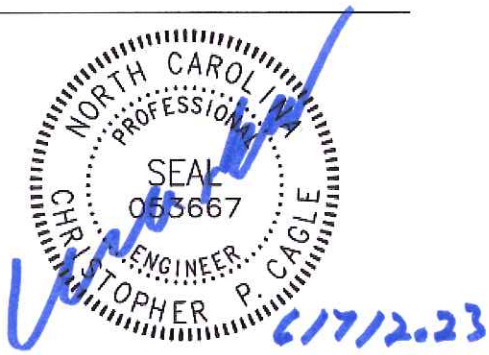
PROJECT MANUAL
including
SPECIFICATIONS
for

GOVERNOR MOREHEAD SCHOOL – BUILDING IV HVAC AND GENERATOR RENOVATION

NC DEPARTMENT OF PUBLIC INSTRUCTION
RALEIGH, NC

Division 01, 26



Division 23

Salas O'Brien
1620 Midtown Place
Raleigh, NC 27609
919-832-8118
salasobrien.com
license (NC): F-1434

DATE: June 7, 2023

PROJECT NUMBERS

SO: 2023-00583

SCO: 22-24490-01A

CODE: ITEM:

SET:

Send all project communication to:
Salas O'Brien

DIVISION 00 - GENERAL CONDITIONS

DIVISION 01 - GENERAL REQUIREMENTS

DIVISION 23 - HVAC TECHNICAL SPECIFICATIONS

DIVISION 26 - ELECTRICAL

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ADVERTISEMENT FOR BIDS

Sealed proposals for Single- Prime bids will be received until 2:00pm on July 13, 2023, at 301 N. Wilmington St, Suite 7029, Raleigh, NC 27601 for construction of Governor Morehead School – Building IV HVAC and Generator Renovation at which time and place bids will be opened and read.

A pre-bid meeting will be held at 2:00pm on Thursday, June 22, 2023, at Governor Morehead School, 301 Ashe Avenue, Raleigh, NC 27606.

Complete plans and specifications for this project can be obtained from

Salas O'Brien
Sarah Johnson
sarah.johnson@salasobrien.com

during normal office hours after June 7, 2023. Plans and Specifications are available electronically (Bid Deposit not required).

The Owner reserves the unqualified right to waive any informalities or reject any and all proposals. All inquires should be directed to:

Signed:

Jonathan Jones
School Planning Section
District Operations Division
NC Department of Public Instruction
301 N. Wilmington St
984-236-2918

STATE OF NORTH CAROLINA
STANDARD FORM OF INFORMAL CONTRACT
AND GENERAL CONDITIONS

FOR

Governor Morehead School – Building IV HVAC and Generator Renovation
NC Department of Public Instruction
Raleigh, NC
SCO# 22-24490-01A

SCOPE OF WORK

The main electrical panel serving Building IV is to be replaced. The main service to the building is not to code with an exterior disconnect; therefore, a new service rated disconnect will be provided. Additionally, a new generator and associated automatic transfer switch will be installed. Finally, new HVAC equipment will be installed to serve various spaces within the building.

NOTICE TO BIDDERS

Sealed bids for this work will be received by:

Jonathan Jones
School Planning Section
NC Department of Public Instruction
301 N. Wilmington St
Raleigh, NC 27699-6319
(984) 236-2918

up to **2:00 PM**, on **July 13, 2023,** immediately thereafter publicly opened and read aloud. Complete plans and specification and contract documents can be obtained from

Salas O'Brien
Sarah Johnson - sarah.johnson@salasobrien.com

A pre-bid meeting will be held at 2:00pm on Thursday, June 22, 2023, at Governor Morehead School, 301 Ashe Avenue, Raleigh, NC 27606.

Contractors are hereby notified that they must have proper license under the State laws governing their respective trades and that North Carolina General Statute 87 will be observed in receiving and awarding contracts. Contractors must have unlimited electrical license classification.

No bid may be withdrawn after the opening of bids for a period of 30 days. The Owner reserves the right to reject any or all bids and waive informalities. Bids shall be made only on the BID/ACEPTANCE form provided herein with all blank spaces for bids properly filled in and all signatures properly executed.

Please note on the envelope – **Bid: Attn:** Jonathan Jones

Governor Morehead School – Building IV HVAC & Generator Upgrades
(Bid Date)
(Contractor)
(License Number)

BID/ACCEPTANCE FORM

for

Governor Morehead School – Building IV HVAC and Generator Renovation
NC Department of Public Instruction
Raleigh, NC
SCO# 22-24490-01A

A new DX split system will be provided for the building's IT Room. The main electrical panel will be replaced with new, and a new service entrance disconnect will be provided. Additionally, a new 35kW diesel generator will be provided for optional standby purposes.

We are in receipt of Addendum _____1 _____2 _____3 _____4

The undersigned, as bidder, proposes and agrees if this bid is accepted to contract with the State of North Carolina through the NC Department of Public Instruction for the furnishing of all materials, equipment, and labor necessary to complete the construction of the work described in these documents in full and complete accordance with plans, specifications, and contract documents, and to the full and entire satisfaction of the State of North Carolina and the NC Department of Public Instruction for the sum of:

BASE BID: Dollars $

(Designer to include this table only if applicable to the project)

Alternate #	Add/Deduct	Alternate bid price	Accepted (*OWNER INITIALS ON EACH LINE INDICATES ACCEPTANCE OF ALTERNATE*)
1			
2			
3			

Respectively submitted this _____day of July 2023

_____

(Contractor's Name)

Federal ID#:_____ By:_____

Witness:_____ Title:_____
(*Owner, partner, corp. Pres. Or Vice President)*

_____ Address:_____
(Proprietorship or Partnership)

Attest: *(corporation)* Email Address:_____

(***Corporate Seal***)

By:_____ License #:_____

Title:_____
(Corporation, Secretary./Ass't Secretary.)

ACCEPTED by the STATE OF NORTH CAROLINA

through the NC Department of Public Instruction

Total amount of accepted by the owner, included base bid: _____

BY:_____ TITLE:_____

G E N E R A L C O N D I T I O N S

1. GENERAL

It is understood and agreed that by submitting a bid that the Contractor has examined these contract documents, drawings and specifications and has visited the site of the Work and has satisfied himself relative to the Work to be performed.

2. DEFINITIONS

Owner: "Owner" shall mean, The State of North Carolina through the NC Department of Public Instruction.

Contractor: "Contractor" shall mean the entity that will provide the services for the Owner.

Designer: The **designer(s)** are those referred to within this contract, or their authorized representatives. The Designer(s), as referred to herein, shall mean architect and/or engineer responsible for preparing the project plans and specifications. They will be referred to hereinafter as if each were of the singular number, masculine gender.

Contract Documents: "Contract Documents" shall consist of the Notice to Bidders; General Conditions of the Contract; special conditions if applicable; Supplementary General Conditions; the drawing and specifications, including all bulletins, addenda or other modifications of the drawings and specifications incorporated into the documents prior to their execution; the bid; the contract; the performance bond if applicable; and insurance certificates. All of these items together form the contract.

INTENT AND EXECUTION OF DOCUMENTS

The drawings and specifications are complementary, one to the other. That which is shown on the drawings or called for in the specifications shall be as binding as if it were both called for and shown. The intent of the drawings and specifications is to establish the scope of all labor, materials, transportation, equipment, and any and all other things necessary to provide a complete job. In case of discrepancy or disagreement in the Contract Documents, the order of precedence shall be: Form of Contract, specifications, large-scale detail drawings, small-scale drawings.

In such cases where the nature of the work requires clarification by the Designer/ Owner, the Designer/ Owner shall furnish such clarification. Clarifications and drawings shall be consistent with the intent of the Contract Documents and shall become a part thereof.

4. AS-BUILT MARKED-UP CONSTRUCTION DOCUMENTS

Contractor shall provide one complete set of legible "as-built" marked-up construction drawings and specifications recording any and all changes made to the original design during the course of construction. In the event no changes occurred, submit construction drawings and specifications set with notation "No Changes." The Designer/Owner must receive "As-built" marked-up construction drawings and specifications before the final pay request can be processed.

5. SUBMITTAL DATA

The Contractor awarded the contract shall submit all specified submittals to the Owner/Designer. A minimum number of copies as specified by the owner, of all required submittal data pertaining to construction, performance and general dimensional criteria of the components listed in the technical specifications shall be submitted. No material or equipment shall be ordered or installed prior to written approval of the submittals by the Designer/Owner. Failure to provide submittal data for review on equipment listed in the technical specifications will result in removal of equipment by the Contractor at his expense if the equipment is not in compliance with the specifications.

6. SUBSTITUTIONS

In accordance with the provisions of G.S. 133-3, material, product, or equipment substitutions proposed by the bidders to those specified herein can only be considered during the bidding phase until five (5) days prior to the receipt of bids or by the date specified in the pre bid conference, when submitted to the Designer with sufficient data to confirm material, product, or equipment equality. Proposed substitutions submitted after this time will be considered only as potential change order.

Submittals for proposed substitutions shall include the following information:

a. Name, address, and telephone number of manufacturer and supplier as appropriate.

b. Trade name, model, or catalog designation.

c. Product data including performance and test data, reference standards, and technical descriptions of material, product, or equipment. Include color samples and samples of available finishes as appropriate.

d. Detailed comparison with specified products including performance capabilities, warranties, and test results.

e. Other pertinent data including data requested by the Designer to confirm product equality.

If a proposed material, product, or equipment substitution is deemed equal by the Designer to those specified, all bidders of record will be notified by Addendum.

7. WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

The contractor shall maintain, in readable condition at his job site one complete set of working drawings and specifications for his work including all shop drawings. Such drawings and specifications shall be available for use by the owner, designer, or his authorized representative.

The contractor shall maintain at the job site, a day-to-day record of work-in-place that is at variance with the contract documents. Such variations shall be fully noted on project drawings by the contractor and submitted to the designer upon project completion and no later than 30 days after acceptance of the project.

8. MATERIALS, EQUIPMENT, EMPLOYEES

a. The contractor shall, unless otherwise specified, supply and pay for all labor, transportation, materials, tools, apparatus, lights, power, fuel, heat, sanitary facilities, water, scaffolding and incidentals necessary for the completion of his work, and shall install, maintain and remove all equipment of the construction, other utensils or things, and be responsible for the safe, proper and lawful construction, maintenance and use of same, and shall construct in the best and most workmanlike manner, a complete job and everything incidental thereto, as shown on the plans, stated in the specifications, or reasonably implied therefrom, all in accordance with the contract documents.

b. All materials shall be new and of quality specified, except where reclaimed material is authorized herein and approved for use. Workmanship shall at all times be of a grade accepted as the best practice of the particular trade involved, and as stipulated in written standards of recognized organizations or institutes of the respective trades except as exceeded or qualified by the specifications.

c. Upon notice, the contractor shall furnish evidence as to quality of materials.

d. Products are generally specified by ASTM or other reference standard and/or by manufacturer's name and model number or trade name. When specified only by reference standard, the Contractor may select any product meeting this standard, by any manufacturer. When several products or manufacturers are specified as being equally acceptable, the Contractor has the option of using any product and manufacturer combination listed. However, the contractor shall be aware that the cited

examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character, and quality of product desired; and that equivalent products will be acceptable. Request for substitution of materials, items, or equipment shall be submitted to the designer for approval or disapproval; the designer prior to the opening of bids shall make such approval or disapproval. Alternate materials may be requested after the award if it can clearly be demonstrated that it is an added benefit to the owner and the designer and owner approves.

e. The designer is the judge of equality for proposed substitution of products, materials, or equipment.

f. If at any time during the construction and completion of the work covered by these contract documents, the language, conduct, or attire of any workman of the various crafts be adjudged a nuisance to the owner or designer, or if any workman be considered detrimental to the work, the contractor shall order such parties removed immediately from grounds.

g. The Contractor shall cooperate with the designer and the owner in coordinating construction activities.

h. The Contractor shall maintain qualified personnel and effective supervision on the site at all times during the project and exercise the appropriate quality control program to ensure compliance with the project drawings and specifications. The designer is responsible for determining compliance with the drawings and specifications.

9. CODES, PERMITS AND INSPECTIONS

The Contractor shall obtain the required permits, if required, give all notices, and comply with all laws, ordinances, codes, rules, and regulations bearing on the conduct of the work under this contract. If the Contractor observes that the drawings and specifications are at variance therewith, he shall promptly notify the Designer in writing. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, codes, rules, and regulations, and without such notice to the Owner, he shall bear all cost arising there from.

All work under this contract shall conform to the current North Carolina Building Code and other state and national codes as are applicable.

Projects constructed by the State of North Carolina or by any agency or institution of the State are not subject to county or municipal building codes and may* not be subject to inspection by county or municipal authorities. Where appropriate, the Contractor shall, cooperate with the county or municipal authorities by obtaining building permits. The contractor at no cost may obtain permits to the owner.

All fire alarm work shall be in accordance with the latest State Construction Office (SCO) *Guidelines for Fire Alarm Installation* (NFPA72). Where the contract documents are in conflict with the SCO guidelines, the SCO guidelines shall govern. The Contractor shall be responsible for all the costs for the correction of the work where he installs it in conflict with the latest edition of the SCO *Guidelines for Fire Alarm Installation*.

*****Inspection and certification of compliance by local authorities is necessary if an architect or engineer was not employed on the project, or if the plans and specifications were not approved and the construction inspected by the State Construction Office.

10. PROTECTION OF WORK, PROPERTY, THE PUBLIC AND SAFETY

a. The contractors shall be jointly responsible for the entire site and the building or construction of the same and provide all the necessary protections, as required by the owner or designer, and by laws or ordinances governing such conditions. They shall be responsible for any damage to the owner's property or of that of others on the job, by them, their personnel, or their subcontractors, and shall make good such damages. They shall be responsible for and pay for any damages caused to the

owner. All contractors shall have access to the project at all times, except as indicated in the Supplemental General Conditions.

b. The contractor shall provide cover and protect all portions of the structure when the work is not in progress, provide and set all temporary roofs, covers for doorways, sash and windows, and all other materials necessary to protect all the work on the building, whether set by him, or any of the subcontractors. Any work damaged through the lack of proper protection or from any other cause, shall be repaired or replaced without extra cost to the owner.

c. No fires of any kind will be allowed inside or around the operations during the course of construction without special permission from the designer and owner.

d. The contractor shall protect all trees and shrubs designated to remain in the vicinity of the operations by building substantial boxes around it. He shall barricade all walks, roads, etc., as directed by the designer to keep the public away from the construction. All trenches, excavations, or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.

e. The contractor shall provide all necessary safety measures for the protection of all persons on the job, including the requirements of the A.G.C. *Accident Prevention Manual in Construction*, as amended, and shall fully comply with all state laws or regulations and North Carolina State Building Code requirements to prevent accident or injury to persons on or about the location of the work. He shall clearly mark or post signs warning of hazards existing, and shall barricade excavations, elevator shafts, stairwells, and similar hazards. He shall protect against damage or injury resulting from falling materials and he shall maintain all protective devices and signs throughout the progress of the work.

f. The contractor shall adhere to the rules, regulations and interpretations of the North Carolina Department of Labor relating to Occupational Safety and Health Standards for the Construction Industry (Title 29, Code of Federal Regulations, Part 1926, published in Volume 39, Number 122, Part II, June 24, 1974, *Federal Register*), and revisions thereto as adopted by General Statutes of North Carolina 95-126 through 155.

i. In the event of emergency affecting the safety of life, the protection of work, or the safety of adjoining properties, the contractor is hereby authorized to act at his own discretion, without further authorization from anyone, to prevent such threatened injury or damage. Any compensation claimed by the contractor on account of such action shall be determined as provided for under Article 13(b).

j. Any and all costs associated with correcting damage caused to adjacent properties of the construction site or staging area shall be borne by the contractor. These costs shall include but not be limited to flooding, mud, sand, stone, debris, and discharging of waste products.

11. SUBCONTRACTS AND SUBCONTRACTORS

The Contractor is and remains fully responsible for his own acts or omissions as well as those of any subcontractor or of any employee of either. The Contractor agrees that no contractual relationship exists between the subcontractor and the Owner in regard to the contract, and that the subcontractor acts on this work as an agent or employee of the Contractor.

12. CONTRACTOR-SUBCONTRACTOR RELATIONSHIPS

The Contractor agrees that the terms of these Contract Documents shall apply equally to each Subcontractor as to the Contractor, and the Contractor agrees to take such action as may be necessary to bind each Subcontractor to these terms. The Contractor further agrees to conform to the Code of Ethical Conduct as adopted by the Associated General Contractors of America, Inc., with respect to Contractor-Subcontractor relationships. The Owner reserves the right to limit the quantity of portions of work to be subcontracted as hereinafter specified.

13. CHANGES IN THE WORK AND CLAIMS FOR EXTRA COST

a. The owner may have changes made in the work covered by the contract. These changes will not invalidate and will not relieve or release the contractor from any guarantee given by him pertinent to the contract provisions. These changes will not affect the validity of the guarantee bond and will not relieve the surety or sureties of said bond. All extra work shall be executed under conditions of the original contract.

b. Except in an emergency endangering life or property, no change shall be made by the contractor except upon receipt of approved change order from the designer, countersigned by the owner authorizing such change. No claim for adjustments of the contract price shall be valid unless this procedure is followed. Should a claim for extra compensation by the contractor be denied by the designer or the owner, the contractor may pursue his claim in accordance with G.S. 143-135.3.

In the event of emergency endangering life or property, the contractor may be directed to proceed on a time and material basis whereupon the contractor shall proceed and keep accurately on such form as specified by the designer or owner, a correct account of costs together with all proper invoices, payrolls and supporting data. Upon completion of the work the change order will be prepared as outlined under either Method "c(1)" or Method "c(2)" or both.

c. In determining the values of changes, either additive or deductive, contractors are restricted to the use of the following methods:

1. Where the extra work involved is covered by unit prices quoted in the proposal, or subsequently agreed to by the Contractor, Designer, Owner and State Construction Office the value of the change shall be computed by application of unit prices based on quantities, estimated or actual as agreed of the items involved, except is such cases where a quantity exceeds the estimated quantity allowance in the contract by one hundred percent (100%) or more. In such cases, either party may elect to proceed under subparagraph c (2) herein. If neither party elects to proceed under c (2), then unit prices shall apply.

2. The contracting parties shall negotiate and agree upon the equitable value of the change prior to issuance of the change order, and the change order shall stipulate the corresponding lump sum adjustment to the contract price.

d. Under Paragraph “b” and Methods "c(2)" above, the allowances for overhead and profit combined shall be as follows: all contractors (the single contracting entity (prime), his subcontractors(1st tier subs), or their sub-subcontractors (2nd tier subs, 3rd tier subs, etc.) shall be allowed a maximum of 10% on work they each self-perform; the prime contractor shall be allowed a maximum of 5% on contracted work of his 1st tier sub; 1st tier, 2nd tier, 3rd tier, etc. contractors shall be allowed a maximum of 2.5% on the contracted work of their subs. ; Under Method "c(1)", no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under Method "c(2)" and Paragraph (b) above, the contractor shall include no less than five percent (5%***)*** profit, but no allowances for overhead.

e. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein shall be limited to the following:

1. The actual costs of materials and supplies incorporated or consumed as part of the work;

2. The actual costs of labor expended on the project site; labor expended in coordination, change order negotiation, record document maintenance, shop drawing revision or other tasks necessary to the administration of the project are considered overhead whether they take place in an office or on the project site.

3. The actual costs of labor burden, limited to the costs of social security (FICA) and Medicare/Medicaid taxes; unemployment insurance costs; health/dental/vision insurance premiums; paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of 30 days per year; retirement contributions; worker's compensation insurance premiums; and the costs of general liability insurance when premiums are computed based on payroll amounts; the total of which shall not exceed thirty percent (30%) of the actual costs of labor;

4. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the work;

5. The actual costs of premiums for bonds, insurance, permit fees and sales or use taxes related to the work.

Overtime and extra pay for holidays and weekends may be a cost item only to the extent approved by the owner.

f. Should concealed conditions be encountered in the performance of the work below grade or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the contract documents, the contract sum and time for completion may be equitably adjusted by change order upon claim by either party made within thirty (30) days after the condition has been identified. The cost of such change shall be arrived at by one of the foregoing methods. All change orders shall be supported by a unit cost breakdown showing method of arriving at net cost as defined above.

g. Change orders shall be submitted by the contractor in writing to the owner/designer for review and approval. The contractor will provide such proposal and supporting data in suitable format. The designer shall verify correctness. Delay in the processing of the change order due to lack of proper submittal by the contractor of all required supporting data shall not constitute grounds for a time extension or basis of a claim. Within fourteen (14) days after receipt of the contractor's accepted proposal including all supporting documentation required by the designer**,** the designer shall prepare the change order and forward to the contractor for his signature or otherwise respond, in writing, to the contractor's proposal. Within seven (7) days after receipt of the change order executed by the contractor, the designer shall, certify the change order by his signature, and forward the change order and all supporting data to the owner for the owner's signature. The owner shall execute the change order**,** within seven (7) days of receipt.

At the time of signing a change order, the contractor shall be required to certify as follows:

"I certify that my bonding company will be notified forthwith that my contract has been changed by the amount of this change order, and that a copy of the approved change order will be mailed upon receipt by me to my surety."

h. A change order, when issued, shall be full compensation, or credit, for the work included, omitted, or substituted. It shall show on its face the adjustment in time for completion of the project as a result of the change in the work.

i. If, during the progress of the work, the owner requests a change order and the contractor's terms are unacceptable, the owner**,** may require the contractor to perform such work on a time and material basis whereupon the contractor shall proceed and keep accurately on such form as specified by the Designer or owner, a correct account of cost together with all proper invoices, payrolls and supporting data. Upon completion of the work a change order will be prepared with allowances for overhead and profit per paragraph d. above and "net cost" and "cost" per paragraph e. above. Without prejudice, nothing in this paragraph shall preclude the owner from performing or to have performed that portion of the work requested in the change order.

14. ANNULMENT OF CONTRACT

If the contractor fails to begin the work under the contract within the time specified, or the progress of the work is not maintained on schedule, or the work is not completed within the time specified, or fails to perform the work with sufficient workmen and equipment or with sufficient materials to ensure the prompt completion of said work, or shall perform the work unsuitably or shall discontinue the prosecution of the work, or if the contractor shall become insolvent or be declared bankrupt or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of forty-eight (48) hours, or shall make an assignment for the benefit of creditors, or for any other cause whatsoever shall not carry on the work in an acceptable manner, the owner may give notice in writing, sent by certified mail, return receipt requested, to the contractor and his surety (if applicable) of such delay, neglect or default, specifying the same, and if the contractor within a period of seven (7) days after such notice shall not proceed in accordance therewith, then the owner shall, declare this contract in default, and, thereupon, the surety shall promptly take over the work and complete the performance of this contract in the manner and within the time frame specified. In the event the contractor, or the surety (if applicable) shall fail to take over the work to be done under this contract within seven (7) days after being so notified and notify the owner in writing, sent by certified mail, return receipt requested, that he is taking the same over and stating that he will diligently pursue and complete the same, the owner shall have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said contractor, to appropriate or use any or all contract materials and equipment on the grounds as may be suitable and acceptable and may enter into an agreement, either by public letting or negotiation, for the completion of said contract according to the terms and provisions thereof or use such other methods as in his opinion shall be required for the completion of said contract in an acceptable manner. All costs and charges incurred by the owner, together with the costs of completing the work under contract, shall be deducted from any monies due or which may become due said contractor and surety (if applicable). In case the expense so incurred by the owner shall be less than the sum which would have been payable under the contract, if it had been completed by said contractor, then the said contractor and surety (if applicable) shall be entitled to receive the difference, but in case such expense shall exceed the sum which would have been payable under the contract, then the contractor and the surety (if applicable) shall be liable and shall pay to the owner the amount of said excess.

15. TERMINATION FOR CONVENIENCE

a. Owner may at any time and for any reason terminate Contractor’s services and work at Owner's convenience, after notification to the contractor in writing via certified mail. Upon receipt of such notice, Contractor shall, unless the notice directs otherwise, immediately discontinue the work and placing of orders for materials, facilities and supplies in connection with the performance of this Agreement.

b. Upon such termination, Contractor shall be entitled to payment only as follows: (1) the actual cost of the work completed in conformity with this Agreement; plus, (2) such other costs actually incurred by Contractor as approved by Owner; (3) plus ten percent (10%) of the cost of the balance of the work to be completed for overhead and profit. There shall be deducted from such sums as provided in this subparagraph the amount of any payments made to Contractor prior to the date of the termination of this Agreement. Contractor shall not be entitled to any claim or claim of lien against Owner for any additional compensation or damages in the event of such termination and payment.

16. OWNER'S RIGHT TO DO WORK

If, during the progress of the work or during the period of guarantee, the contractor fails to prosecute the work properly or to perform any provision of the contract, the owner, after seven (7) days' written notice sent by certified mail, return receipt requested, to the contractor from the designer, may perform or have performed that portion of the work. The cost of the work may be deducted from any amounts due or to become due to the contractor, such action and cost of same having been first approved by the designer. Should the cost of such action of the owner exceed the amount due or to become due the contractor, then the contractor or his surety, or both, shall be liable for and shall pay to the owner the amount of said excess.

17. REQUESTS FOR PAYMENT

Contractor shall refer to the Supplemental General Conditions for specific directions on payment schedule, procedures and the name and address where to send applications for payments for this project. It is imperative that invoices be sent only to the above address in order to assure proper and timely delivery and handling.

The Designer/Owner will process all Contractor pay requests as the project progresses. The Contractor shall receive payment within thirty (30) consecutive days after Designer/Owner's approval of each pay request. Payment will only be made for work performed as determined by the Designer/Owner.

Retainage:

a. Retainage withheld will not exceed 5% at any time.
b. The same terms apply to general contractor and subcontractors alike.
c. Following 50% completion of the project no further retainage will be withheld if the contractor/subcontractor has performed their work satisfactorily.
d. Exceptions:
    1. Owner/Contractor can reinstate retainage if the contractor/subcontractor does not continue to perform satisfactorily.
    2. Following 50% completion of the project, the owner is authorized to withhold additional retainage from a subsequent periodic payment if the amount of retainage withheld falls below 2.5%.

Final payment will be made within forty-five (45) consecutive days after acceptance of the work, receipt of marked-up "as-built" drawings and specifications and the submission both of notarized Contractor's affidavit and final pay request. All pay requests shall be submitted to the Designer/Owner for approval.

THE CONTRACTOR'S FINAL PAYMENT AFFIDAVIT SHALL STATE: "THIS IS TO CERTIFY THAT ALL COSTS OF MATERIALS, EQUIPMENT, LABOR, SUBCONTRACTED WORK, AND ALL ELSE ENTERING INTO THE ACCOMPLISHMENT OF THIS CONTRACT, INCLUDING PAYROLLS, HAVE BEEN PAID IN FULL."

18. PAYMENTS WITHHELD

The designer with the approval of the Owner may withhold payment for the following reasons:

a. Faulty work not corrected.

b. The unpaid balance on the contract is insufficient to complete the work in the judgment of the designer.

c. To provide for sufficient contract balance to cover liquidated damages that will be assessed.

d. The secretary of the Department of Administration may authorize the withholding of payment for the following reasons:

    i. Claims filed against the contractor or evidence that a claim will be filed.

    ii. Evidence that subcontractors have not been paid.

When grounds for withholding payments have been removed, payment will be released. Delay of payment due the contractor without cause will make owner liable for payment of interest to the contractor as provided in G.S. 143-134.**1.** As provided in G.S. 143-134.1(e), the owner shall not be liable for interest on payments withheld by the owner for unsatisfactory job progress, defective construction not remedied, disputed work, or third-party claims filed against the owner or reasonable evidence that a third-party claim will be filed.

19. MINIMUM INSURANCE REQUIREMENTS

The work under this contract shall not commence until the contractor has obtained all required insurance and verifying certificates of insurance have been approved in writing by the owner. These certificates shall document that coverages afforded under the policies will not be cancelled, reduced in amount or coverages eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the owner of such alteration or cancellation. If endorsements are needed to comply with the notification or other requirements of this article copies of the endorsements shall be submitted with the certificates.

a. **Worker's Compensation and Employer's Liability**

The contractor shall provide and maintain, until final acceptance, workmen's compensation insurance, as required by law, as well as employer's liability coverage with minimum limits of $100,000.

b. **Public Liability and Property Damage**

The contractor shall provide and maintain, until final acceptance, comprehensive general liability insurance, including coverage for premises operations, independent contractors, completed operations, products and contractual exposures, as shall protect such contractors from claims arising out of any bodily injury, including accidental death, as well as from claims for property damages which may arise from operations under this contract, whether such operations be by the contractor or by any subcontractor, or by anyone directly or indirectly employed by either of them and the minimum limits of such insurance shall be as follows:

Bodily Injury:	$500,000 per occurrence
Property Damage:	$100,000 per occurrence / $300,000 aggregate

In lieu of limits listed above, a $500,000 combined single limit shall satisfy both conditions.

Such coverage for completed operations must be maintained for at least two (2) years following final acceptance of the work performed under the contract.

c. **Property Insurance (Builder's Risk/Installation Floater)**

The contractor shall purchase and maintain property insurance until final acceptance, upon the entire work at the site to the full insurable value thereof. This insurance shall include the interests of the owner, the contractor, the subcontractors, and sub-subcontractors in the work and shall insure against the perils of fire, wind, rain, flood, extended coverage, and vandalism and malicious mischief. If the owner is damaged by failure of the contractor to purchase or maintain such insurance, then the contractor shall bear all reasonable costs properly attributable thereto; the contractor shall effect and maintain similar property insurance on portions of the work stored off the site when request for payment per articles so includes such portions.

d. **Deductible**

Any deductible, if applicable to loss covered by insurance provided, is to be borne by the contractor.

e. **Other Insurance**

The contractor shall obtain such additional insurance as may be required by the owner or by the General Statutes of North Carolina including motor vehicle insurance, in amounts not less than the statutory limits.

f. **Proof of Carriage**

The contractor shall furnish the owner with satisfactory proof of carriage of the insurance required before written approval is granted by the owner.

20. ASSIGNMENT

No assignment of the Contractor's obligations or the Contractor's right to receive payment hereunder shall be permitted. However, upon written request approved by the Owner and solely as a convenience to the Contractor, the Owner may: (1) forward the Contractor's payment check directly to any person or entity designated by the Contractor, and (2) include any person or entity designated by Contractor as a joint payee on the Contractor's payment check. In no event shall such approval and action obligate the Owner to anyone other than the Contractor, and the Contractor shall remain responsible for fulfillment of all contract obligations.

21. CLEANING UP AND RESTORATION OF SITE

The Contractor shall keep the sites and surrounding area reasonably free from rubbish at all times and shall remove debris from the site from time to time or when directed to do so by the Owner. Before final inspection and acceptance of the project, the Contractor shall thoroughly clean the sites, and completely prepare the project and site for use by the Owner.

At the end of construction, the contractor shall oversee and implement the restoration of the construction site to its original state. Restoration includes but not limited to walks, drives, lawns, trees and shrubs, corridors, stairs, and other elements shall be repaired, cleaned, or otherwise restored to their original state.

22. GUARANTEE

The contractor shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship, or negligence for a period of twelve (12) months following the final acceptance of the work and shall replace such defective materials or workmanship without cost to the owner.

Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material. The contractor shall replace such defective equipment or materials, without cost to the owner, within the manufacturer's warranty period.

Additionally, the owner may bring an action for latent defects caused by the negligence of the contractor, which is hidden or not readily apparent to the owner at the time of beneficial occupancy or final acceptance, whichever occurred first, in accordance with applicable law.

Guarantees for roofing workmanship and materials shall be stipulated in the specifications sections governing such roof, equipment, materials, or supplies.

23. STANDARDS

All manufactured items and/or fabricated assemblies subject to operation under pressure, operation by connection to an electric source, or operation involving a connection to a manufactured, natural, or LP gas source shall be constructed and approved in a manner acceptable to the appropriate State inspector which customarily requires the label or re-examination listing or identification marking of appropriate safety standard organization, such as the American Society of Mechanical Engineers for pressure vessels; the Underwriters Laboratories and/or National Electrical Manufacturers Association for electrically operated assemblies; or the American Gas Association for gas operated assemblies, where such approvals of listings have been established for the type of device offered and furnished. Further, all items furnished shall meet all requirements of the Occupational Safety and Health Act (OSHA), and State and federal requirements relating to clean air and water pollution.

All equipment and products must be independent third party tested and labeled (UL, FM, or CTS) before final connections to Owner services or utilities.

24. TAXES

a. Federal excise taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3442(3)).

b. Federal transportation taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3475(b) as amended).

c. North Carolina sales tax and use tax, as required by law, do apply to materials entering into state work and such costs shall be included in the bid proposal and contract sum.

d. Local option sales and use taxes, as required by law, do apply to materials entering into state work as applicable and such costs shall be included in the bid proposal and contract sum.

e. **Accounting Procedures for Refund of County Sales & Use Tax**

Amount of county sales and use tax paid per contractor's statements:

Contractors performing contracts for state agencies shall give the state agency for whose project the property was purchased a signed statement containing the information listed in G.S. 105-164.14(e).

The Department of Revenue has agreed that in lieu of obtaining copies of sales receipts from contractors, an agency may obtain a certified statement as of April 1, 1991, from the contractor setting forth the date, the type of property and the cost of the property purchased from each vendor, the county in which the vendor made the sale and the amount of local sales and use taxes paid thereon. If the property was purchased out-of-state, the county in which the property was delivered should be listed. The contractor should also be notified that the certified statement may be subject to audit.

In the event the contractors make several purchases from the same vendor, such certified statement must indicate the invoice numbers, the inclusive dates of the invoices, the total amount of the invoices, the counties, and the county sales and use taxes paid thereon.

Name of taxing county: The position of a sale is the retailer's place of business located within a taxing county where the vendor becomes contractually obligated to make the sale. Therefore, it is important that the county tax be reported for the county of sale rather than the county of use.

When property is purchased from out-of-state vendors and the county tax is charged, the county should be identified where delivery is made when reporting the county tax.

Such statement must also include the cost of any tangible personal property withdrawn from the contractor's warehouse stock and the amount of county sales or use tax paid thereon by the contractor.

Similar certified statements by his subcontractors must be obtained by the general contractor and furnished to the claimant.

Contractors are not to include any tax paid on supplies, tools, and equipment which they use to perform their contracts and should include only those building materials, supplies, fixtures and equipment which actually become a part of or annexed to the building or structure.

25. EQUAL OPPORTUNITY CLAUSE

The non-discrimination clause contained in Section 202 (Federal) Executive Order 11246, as amended by Executive Order 11375, relative to equal employment opportunity for all persons without regard to race, color, religion, sex or national origin, and the implementing rules and regulations prescribed by the secretary of Labor, are incorporated herein.

The contractor(s) agree not to discriminate against any employee or applicant for employment because of physical or mental disabilities in regard to any position for which the employee or applicant is qualified. The contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified individuals with such disabilities without discrimination based upon their physical or mental disability in all employment practices.

26. MINORITY BUSINESS PARTICIPATION

GS 143-128.2 establishes a ten percent (10%) goal for participation by minority business in total value of work for each State building project.

For construction contracts with a value of less than $300,000, the Owner has the responsibility to make a good faith effort to solicit minority bids and to attain the goal. The contractor shall include with his bid a completed Identification of HUB Certified/Minority Business Participation form. Contractor shall submit completed Appendix E MBE Documentation for Contract Payments form with final payment request.

For construction contracts with a value of $300,000 or greater, the contractor shall comply with the document *Guidelines for* Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts including Identification of Minority Business Participation, Affidavits A, B, C, and D, and Appendix E. These forms provided herein are hereby incorporated and made a part of this contract.

27. ACCESS TO PERSONS AND RECORDS

The State Auditor shall have access to persons and records as a result of all contracts or grants entered into by the Owner in accordance with General Statute 147-64.7. The Owner's internal auditors shall also have the right to access and copy the Contractor's records relating to the Contract and Project during the term of the Contract and within two years following the completion of the Project/close-out of the Contract to verify accounts, accuracy, information, calculations and/or data affecting and/or relating to Contractor's requests for payment, requests for change orders, change orders, claims for extra work, requests for time extensions and related claims for delay/extended general conditions costs, claims for lost productivity, claims for lost efficiency, claims for idle equipment or labor, claims for price/cost escalation, pass-through claims of subcontractors and/or suppliers, and/or any other type of claim for payment or damages from Owner and/or its project representatives.

28. GOVERNING LAWS

This contract is made under and shall be governed by and construed in accordance with the laws of the State of North Carolina. The Contractor shall comply with all applicable federal, State, and local laws, statutes, ordinances and regulations including, but not limited to, the Omnibus Transportation Act of 1991 and its implementing regulations.

29. CONTRACTOR EVALUATION

The contractor's overall work performance on the project shall be fairly evaluated in accordance with the State Building Commission policy and procedures, for determining qualifications to bid on future State projects. In addition to final evaluation, an interim evaluation may be prepared during the progress of project. The owner may request the contractor's comments to evaluate the designer.

SUPPLEMENTARY GENERAL CONDITIONS

TIME OF COMPLETION

The Contractor shall commence work to be performed under this Contract on a date to be specified in written order from the Designer/Owner and shall fully complete all work hereunder within 120 consecutive calendar days from the Notice to Proceed. For each day in excess of the above number of days, the Contractor shall pay the Owner the amount of One Hundred Dollars ($100) as liquidated damages reasonably estimated in advance to cover the losses to be incurred by the Owner should the Contractor fail to complete the Work within the time specified.

If the Contractor is delayed at **anytime** in the progress of his work by any act or negligence of the Owner, his employees or his separate contractor, by changes ordered in the work; by abnormal weather conditions; by any causes beyond the Contractor's control or by other causes deemed justifiable by Owner, then the contract time may be reasonably extended in a written order from the Owner upon written request from the contractor within ten days following the cause for delay. Time extensions for weather delays, acts of God, labor disputes, fire, delays in transportation, unavoidable casualties or other delays which are beyond the control of the Owner do not entitle the Contractor to compensable damages for delays. Any contractor claim for compensable damages for delays is limited to delays caused solely by the owner or its agents.

MINIMUM INSURANCE REQUIREMENTS

The modification of the 30-day cancellation notice to the certificate form is no longer accepted. Provide Insurance certificates with language appropriately inserted in the insurance certificate block provided for Special Provisions, as follows:

> "Notwithstanding the preprinted cancellation provisions on this form, coverages afforded under the policies will not be cancelled, reduced in amount nor will any coverages be eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the owner, of such alteration or cancellation." ***[This language can be continued on an attached and properly titled continuation sheet as long as the first clause ("Notwithstanding….form,") is on the face of the form]***

Document that the insurance policy contract(s) include(s) the required cancellation provision. If an endorsement is required to comply with Article 19 of these General Conditions, provide a copy of the endorsement.

PERFORMANCE AND PAYMENT BONDS

Contractor shall furnish a Performance Bond and Payment Bond executed by a surety company authorized to do business in North Carolina. The bonds shall be in the full contract amount. Bonds shall be executed in the form bound with these specifications (Forms 307 & 308). An authorized agent of the bonding company who is licensed to do business in North Carolina shall countersign all bonds.

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal (Contractor) _____

Name of Surety: _____

Name of Contracting Body: _____

Amount of Bond: _____

Project

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

_____

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(CORPORATE SEAL)

_____
Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

_____
(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

Witness: _____

Countersigned:

_____

(N.C. Licensed Resident Agent)

_____

Name and Address-Surety Agency

_____

Surety Company Name and N.C. Regional or Branch Office Address

(Surety Corporate Seal)

FORM OF PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal (Contractor) _____

Name of Surety: _____

Name of Contracting Body: _____

Amount of Bond: _____

Project _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

_____

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(CORPORATE SEAL)

_____
Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

_____
(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

Witness: _____

Countersigned:

_____

_____
(N.C. Licensed Resident Agent)

_____

_____
Name and Address-Surety Agency

_____

_____
Surety Company Name and N.C. Regional or Branch Office Address

(Surety Corporate Seal)

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

GUIDELINES FOR RECRUITMENT AND SELECTION OF MINORITY BUSINESSES FOR PARTICIPATION IN STATE CONSTRUCTION CONTRACTS

In accordance with G.S. 143-128.2 (effective January 1, 2002) these guidelines establish goals for minority participation in single-prime bidding, separate-prime bidding, construction manager at risk, and alternative contracting methods, on State construction projects in the amount of $300,000 or more. The legislation provides that the State shall have a verifiable ten percent (10%) goal for participation by minority businesses in the total value of work for each project for which a contract or contracts are awarded. These requirements are published to accomplish that end.

SECTION A: INTENT

It is the intent of these guidelines that the State of North Carolina, as awarding authority for construction projects, and the contractors and subcontractors performing the construction contracts awarded shall cooperate and in good faith do all things legal, proper and reasonable to achieve the statutory goal of ten percent (10%) for participation by minority businesses in each construction project as mandated by GS 143-128.2. Nothing in these guidelines shall be construed to require contractors or awarding authorities to award contracts or subcontracts to or to make purchases of materials or equipment from minority-business contractors or minority-business subcontractors who do not submit the lowest responsible, responsive bid or bids.

SECTION B: DEFINITIONS

1. Minority - a person who is a citizen or lawful permanent resident of the United States and who is:
   a. Black, that is, a person having origins in any of the black racial groups in Africa;
   b. Hispanic, that is, a person of Spanish or Portuguese culture with origins in Mexico, South or Central America, or the Caribbean Islands, regardless of race;
   c. Asian American, that is, a person having origins in any of the original peoples of the Far East, Southeast Asia and Asia, the Indian subcontinent, the Pacific Islands;
   d. American Indian, that is, a person having origins in any of the original peoples of North America; or
   e. Female

2. Minority Business - means a business:
   a. In which at least fifty-one percent (51%) is owned by one or more minority persons, or in the case of a corporation, in which at least fifty-one percent (51%) of the stock is owned by one or more minority persons or socially and economically disadvantaged individuals; and
   b. Of which the management and daily business operations are controlled by one or more of the minority persons or socially and economically disadvantaged individuals who own it.

3. Socially and economically disadvantaged individual - means the same as defined in 15 U.S.C. 637. "Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities". "Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged".

4. Public Entity - means State and all public subdivisions and local governmental units.

5. Owner - The State of North Carolina, through the Agency/Institution named in the contract.

6. Designer – Any person, firm, partnership, or corporation, which has contracted with the State of North Carolina to perform architectural or engineering, work.

7. Bidder - Any person, firm, partnership, corporation, association, or joint venture seeking to be awarded a public contract or subcontract.
8. Contract - A mutually binding legal relationship or any modification thereof obligating the seller to furnish equipment, materials or services, including construction, and obligating the buyer to pay for them.

9. Contractor - Any person, firm, partnership, corporation, association, or joint venture which has contracted with the State of North Carolina to perform construction work or repair.

10. Subcontractor - A firm under contract with the prime contractor or construction manager at risk for supplying materials or labor and materials and/or installation. The subcontractor may or may not provide materials in his subcontract.

SECTION C: RESPONSIBILITIES

1. Office for Historically Underutilized Businesses, Department of Administration (hereinafter referred to as HUB Office).

The HUB Office has established a program, which allows interested persons or businesses qualifying as a minority business under G.S. 143-128.2, to obtain certification in the State of North Carolina procurement system. The information provided by the minority businesses will be used by the HUB Office to:

a. Identify those areas of work for which there are minority businesses, as requested.
b. Make available to interested parties a list of prospective minority business contractors and subcontractors.
c. Assist in the determination of technical assistance needed by minority business contractors.

In addition to being responsible for the certification/verification of minority businesses that want to participate in the State construction program, the HUB Office will:

(1) Maintain a current list of minority businesses. The list shall include the areas of work in which each minority business is interested.
(2) Inform minority businesses on how to identify and obtain contracting and subcontracting opportunities through the State Construction Office and other public entities.
(3) Inform minority businesses of the contracting and subcontracting process for public construction building projects.
(4) Work with the North Carolina trade and professional organizations to improve the ability of minority businesses to compete in the State construction projects.
(5) The HUB Office also oversees the minority business program by:
    a. Monitoring compliance with the program requirements.
    b. Assisting in the implementation of training and technical assistance programs.
    c. Identifying and implementing outreach efforts to increase the utilization of minority businesses.
    d. Reporting the results of minority business utilization to the Secretary of the Department of Administration, the Governor, and the General Assembly.

2. State Construction Office

The State Construction Office will be responsible for the following:

a. Furnish to the HUB Office a minimum of twenty-one days prior to the bid opening the following:
    (1) Project description and location;
    (2) Locations where bidding documents may be reviewed;
    (3) Name of a representative of the owner who can be contacted during the advertising period to advise who the prospective bidders are;
    (4) Date, time and location of the bid opening.
    (5) Date, time and location of prebid conference, if scheduled.

b. Attending scheduled prebid conference, if necessary, to clarify requirements of the general statutes regarding minority-business participation, including the bidders' responsibilities.
c. Reviewing the apparent low bidders' statutory compliance with the requirements listed in the proposal, that must be complied with, if the bid is to be considered as responsive, prior to award of contracts. The State reserves the right to reject any or all bids and to waive informalities.
d. Reviewing of minority business requirements at Preconstruction conference.

e. Monitoring of contractors' compliance with minority business requirements in the contract documents during construction.
f. Provide statistical data and required reports to the HUB Office.
g. Resolve any protest and disputes arising after implementation of the plan, in conjunction with the HUB Office.

3. Owner
Before awarding a contract, owner shall do the following:

a. Develop and implement a minority business participation outreach plan to identify minority businesses that can perform public building projects and to implement outreach efforts to encourage minority business participation in these projects to include education, recruitment, and interaction between minority businesses and non-minority businesses.
b. Attend the scheduled prebid conference.
c. At least 10 days prior to the scheduled day of bid opening, notify minority businesses that have requested notices from the public entity for public construction or repair work and minority businesses that otherwise indicated to the Office for Historically Underutilized Businesses an interest in the type of work being bid or the potential contracting opportunities listed in the proposal. The notification shall include the following:
    1. A description of the work for which the bid is being solicited.
    2. The date, time, and location where bids are to be submitted.
    3. The name of the individual within the owner's organization who will be available to answer questions about the project.
    4. Where bid documents may be reviewed.
    5. Any special requirements that may exist.
d. Utilize other media, as appropriate, likely to inform potential minority businesses of the bid being sought.
e. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
f. Review, jointly with the designer, all requirements of G.S. 143-128.2(c) and G.S. 143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with corresponding total dollar value of the bid and affidavit listing good faith efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award to the State Construction Office.
g. Evaluate documentation to determine good faith effort has been achieved for minority business utilization prior to recommendation of award to State Construction Office.
h. Review prime contractors' pay applications for compliance with minority business utilization commitments prior to payment**.**
i. Make documentation showing evidence of implementation of Owner's responsibilities available for review by State Construction Office and HUB Office, upon request

4. Designer
Under the single-prime bidding, separate prime bidding, construction manager at risk, or alternative contracting method, the designer will:

a. Attend the scheduled prebid conference to explain minority business requirements to the prospective bidders.
b. Assist the owner to identify and notify prospective minority business prime and subcontractors of potential contracting opportunities.
c. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
d. Review jointly with the owner, all requirements of G.S. 143-128.2(c) and G.S.143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with corresponding total dollar value of the bid and affidavit listing Good Faith Efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award.

e. During construction phase of the project, review "MBE Documentation for Contract Payment" – (Appendix E) for compliance with minority business utilization commitments. Submit Appendix E form with monthly pay applications to the owner and forward copies to the State Construction Office.
f. Make documentation showing evidence of implementation of Designer's responsibilities available for review by State Construction Office and HUB Office, upon request.

5. Prime Contractor(s), CM at Risk, and Its First-Tier Subcontractors
Under the single-prime bidding, the separate-prime biding, construction manager at risk and alternative contracting methods, contractor(s) will:

a. Attend the scheduled prebid conference.
b. Identify or determine those work areas of a subcontract where minority businesses may have an interest in performing subcontract work.
c. At least ten (10) days prior to the scheduled day of bid opening, notify minority businesses of potential subcontracting opportunities listed in the proposal. The notification will include the following:
   (1) A description of the work for which the subbid is being solicited.
   (2) The date, time and location where subbids are to be submitted.
   (3) The name of the individual within the company who will be available to answer questions about the project.
   (4) Where bid documents may be reviewed.
   (5) Any special requirements that may exist, such as insurance, licenses, bonds and financial arrangements.

   If there are more than three (3) minority businesses in the general locality of the project who offer similar contracting or subcontracting services in the specific trade, the contractor(s) shall notify three (3), but may contact more, if the contractor(s) so desires.
d. During the bidding process, comply with the contractor(s) requirements listed in the proposal for minority participation.
e. Identify on the bid**,** the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit listing good faith efforts as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).
f. Make documentation showing evidence of implementation of Prime Contractor, CM-at-Risk and First-Tier Subcontractor responsibilities available for review by State Construction Office and HUB Office, upon request.
g. Upon being named the apparent low bidder, the Bidder shall provide one of the following: (1) an affidavit (Affidavit C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal; (2) if the percentage is not equal to the applicable goal, then documentation of all good faith efforts taken to meet the goal. Failure to comply with these requirements is grounds for rejection of the bid and award to the next lowest responsible and responsive bidder.
h. The contractor(s) shall identify the name(s) of minority business subcontractor(s) and corresponding dollar amount of work on the schedule of values. The schedule of values shall be provided as required in Article 31 of the General Conditions of the Contract to facilitate payments to the subcontractors.
i. The contractor(s) shall submit with each monthly pay request(s) and final payment(s), "MBE Documentation for Contract Payment" – (Appendix E), for designer's review.
j. During the construction of a project, at any time**,** if it becomes necessary to replace a minority business subcontractor, immediately advise the owner, State Construction Office, and the Director of the HUB Office in writing**,** of the circumstances involved. The prime contractor shall make a good faith effort to replace a minority business subcontractor with another minority business subcontractor.
k. If during the construction of a project additional subcontracting opportunities become available, make a good faith effort to solicit subbids from minority businesses.
l. It is the intent of these requirements apply to all contractors performing as prime contractor and first tier subcontractor under construction manager at risk on state projects.

6. Minority Business Responsibilities
While minority businesses are not required to become certified in order to participate in the State construction projects, it is recommended that they become certified and should take advantage of the

appropriate technical assistance that is made available. In addition, minority businesses who are contacted by owners or bidders must respond promptly whether or not they wish to submit a bid.

SECTION D: DISPUTE PROCEDURES

It is the policy of this state that disputes that involves a person's rights, duties or privileges, should be settled through informal procedures. To that end, minority business disputes arising under these guidelines should be resolved as governed under G.S. 143-128(g).

SECTION E: These guidelines shall apply upon promulgation on state construction projects. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 733-7962, Website: http://interscope2.doa.state.nc.us/main.htm.

SECTION F: In addition to these guidelines, there will be issued with each construction bid package provisions for contractual compliance providing minority business participation in the state construction program.

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts** are hereby made a part of these contract documents. These guidelines shall apply to all contractors regardless of ownership. Copies of theses guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 733-7962, Website: http://interscope2.doa.state.nc.us/main.htm.

MINORITY BUSINESS SUBCONTRACT GOALS:

The goals for participation by minority firms as subcontractors on this project have been set at 10%.

The bidder must identify on its bid (by using the Identification of Minority Business Participation Form provided in the bid document), the minority businesses that will be utilized on the project with corresponding total dollar value of the bid. In addition, the bidder must submit with its bid, either an affidavit (Affidavit A) listing good faith efforts **or** an affidavit (Affidavit B) of self-performance of work, if the bidder will perform work under contract by its own workforce, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).

The lowest responsible, responsive bidder must provide Affidavit C, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal.

OR

Provide Affidavit D, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, **with documentation of Good Faith Effort, if the percentage is not equal to the applicable goal.**

OR

Provide Affidavit B, which includes sufficient information for the State to determine that the bidder does not customarily subcontract work on this type project.

The above information must be provided as required. Failure to submit these documents is grounds for rejection of the bid.

MINIMUM COMPLIANCE REQUIREMENTS:

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and the State for performance of this contract. Failure to comply with any of these statements, affidavits or intentions, or with the minority business Guidelines shall constitute a breach of the contract. A finding by the State that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false or incomplete, shall also constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of the State whether to terminate the contract for breach.

In determining whether a contractor has made Good Faith Efforts, the State will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts. Good Faith Efforts include:

(1) Contacting minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists at least 10 days before the bid or proposal date and notifying them of the nature and scope of the work to be performed.

(2) Making the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bid or proposals are due.

(3) Breaking down or combining elements of work into economically feasible units to facilitate minority participation.

(4) Working with minority trade, community, or contractor organizations identified by the Office for Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.

(5) Attending any prebid meetings scheduled by the public owner.

(6) Providing assistance in getting required bonding or insurance or providing alternatives to bonding or insurance for subcontractors.

(7) Negotiating in good faith with interested minority businesses and not rejecting them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.

(8) Providing assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisting minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.

(9) Negotiating joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.

(10) Providing quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

The following is a list of payments made to Minority Business Enterprises on this project for the above-mentioned period.

MBE FIRM NAME	* INDICATE TYPE OF MBE	AMOUNT PAID THIS MONTH	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Social and Economically Disadvantage (D)

Date: _____ Approved/Certified By: _____
Name

_____
Title

_____
Signature

SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT

(Revised on 3/14/2003)

Identification of HUB Certified/ Minority Business Participation

I,_____,
(Name of Bidder)
do hereby certify that on this project, we will use the following HUB Certified/ minority business as construction subcontractors, vendors, suppliers or providers of professional services.

Firm Name, Address and Phone #	Work Type	*Minority Category	**HUB Certified (Y/N)

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

The total value of minority business contracting will be ($)_____.

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of_____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ❑ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ❑ **2 --(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ❑ **3** – **(15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ❑ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ❑ **5** – **(10 pts)** Attended prebid meetings scheduled by the public owner.
- ❑ **6** – **(20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ❑ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ❑ **8** – **(25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ❑ **9** – **(20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ❑ **10** - **(20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_____ Name of Authorized Officer:_____

Signature:_____

Title:_____

SEAL

State of_____, County of_____

Subscribed and sworn to before me this _____day of _____20____

Notary Public_____

My commission expires _____

State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract with Own Workforce.

County of _____

Affidavit of _____
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____

_____ contract.
(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____

SEAL

State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20___

Notary Public _____

My commission expires _____

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.
This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

_____
(Project Name)

Project ID#_____ Amount of Bid $_____

I will expend a minimum of _____% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. Attach additional sheets if required

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_____ Name of Authorized Officer:_____

SEAL

Signature:_____

Title:_____

State of _____, County of _____
Subscribed and sworn to before me this _____day of _____20____
Notary Public_____
My commission expires_____

State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

_____
(Project Name)

Project ID#_____ Amount of Bid $_____

I will expend a minimum of _____% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. (Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

***Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

****** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

A. Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.

B. Copies of quotes or responses received from each firm responding to the solicitation.

C. A telephone log of follow-up calls to each firm sent a solicitation.

D. For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.

E. Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.

F. Copy of pre-bid roster

G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.

H. Letter detailing reasons for rejection of minority business due to lack of qualification.

I. Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_____ Name of Authorized Officer:_____

Signature:_____

Title:_____

SEAL

State of _____, County of _____

Subscribed and sworn to before me this _____day of _____20____

Notary Public_____

My commission expires _____

SECTION 011100 - SUMMARY OF THE WORK

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to this section.

WORK COVERED BY CONTRACT DOCUMENTS

The Work of the Project is defined by the Contract Documents and generally consists of the following:

The main electrical panel serving Building IV is to be replaced. The main service to the building is not to code with an exterior disconnect; therefore, a new service rated disconnect will be provided. Additionally, a new generator and associated automatic transfer switch will be installed. Finally, new HVAC equipment will be installed to serve various spaces within the building.

ACCESS TO SITE

Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

WORK RESTRICTIONS

General Work Restrictions: Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

Owner's work rules and/or restrictions on construction operations, as appended at the end of this Section, must be adhered to by all Contractor personnel.

Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 019913 - GENERAL REQUIREMENTS FOR DIVISIONS 21-28 WORK

The "Engineer of Record" for the work defined by Division 01 is Salas O'Brien, 1620 Midtown Place (27609), P.O. Box 19944 (27619), Raleigh, NC, (919) 832-8118. The term "engineer," "architect-engineer," "engineer-architect," "A-E," "E-A," etc., when used in these Sections shall reference Salas O'Brien.

The "Engineer of Record" for the work defined by Divisions 21-28 is Salas O'Brien., 1620 Midtown Place (27609), P.O. Box 19944 (27619), Raleigh, NC, (919) 832-8118. The term "engineer," "architect-engineer," "engineer-architect," "A-E," "E-A," etc., when used in Divisions 21-28 Drawings and Specifications shall reference Salas O'Brien.

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to this section.

The requirements specified herein shall govern all Sections, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

REVIEW OF CONTRACT DOCUMENTS

The Contract Documents may represent imperfect data and may contain errors, omissions, conflicts, inconsistencies, code violations and improper use of materials. Such deficiencies will be corrected by the A-E when identified. The Contractor shall carefully study and compare the individual Contract Documents with each other and report at once in writing to the A-E any deficiencies the Contractor may discover. The Contractor shall require each subcontractor to likewise study the documents and report at once any deficiencies discovered. The Contractor shall resolve all reported deficiencies with the A-E prior to starting any work. **Any work performed prior to receipt of instructions from the A-E will be done at the Contractor's risk.** If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency, or omission in the Contract Documents without such notice to the A-E, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

The Contractor shall be responsible for maintaining habitable structures under this Contract rainproof, and for making equipment and utility installations properly perform the intended function. If he is prevented from so doing by any limitations of the drawings or specifications, the Contractor shall immediately notify the A-E in writing of such limitations before proceeding with construction in the area where the problem or limitation exists.

DEFINITIONS

Mechanical Work: Work required by this Contract as defined by specification Division 23 (Heating, Ventilating, and Air-Conditioning).

Electrical Work: Work required by this Contract as defined by specification Divisions 26-28.

Labeled: Appliances, equipment, materials or products to which has been attached a label, symbol, or other identifying mark of an organization acceptable to the North Carolina Building Code Council and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with identified standards or has been tested and found suitable for a specified purpose.

Listed: Appliances, equipment, materials or products included in a list published by an organization acceptable to the North Carolina Building Code Council and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate designated standards or has been tested and found suitable for a specified purpose.

Concealed: Work within or behind various construction elements or in crawl spaces or trenches that is not exposed to view when the project is complete.

Exposed: Not "concealed" as defined above, or anything exposed to view when the project is complete.

Wiring: Cable, raceways, fittings, mechanical supports, wire, junction boxes, device boxes, outlet boxes, switches, cutouts, and related items.

CODES, LAWS, REGULATIONS, AND STANDARDS

Work on and for the project shall conform to requirements of each applicable volume of the *North Carolina Building Code*; shall comply with the regulations of the N.C. Department of Labor, including the latest revisions and interpretations of the *Occupational Safety and Health Act of North Carolina;* and be in accordance with all other codes, laws, rules and regulations that apply to this project.

"Confined spaces" and "permit-requiring confined spaces", as defined by U.S. Occupational Safety and Health Administration (USOSHA) may exist in the work area or may be created by the construction of this Project. The Contractor shall be responsible for identification of any permit-requiring confined spaces and for establishing all required procedures for meeting the requirements of USOSHA relative to these spaces, including written confined space entry program(s).

Codes, laws, regulations, and/or industry standards referenced in the Specification or on the Drawings shall be considered to be part of the Project requirements. Applicable edition of the referenced volume is the edition that is/was in effect at the time the construction permit was issued or at the time of approval of the Contract Documents by the Authority Having Jurisdiction.

INTENT AND WORKMANSHIP

The words "furnish," "furnish and install," "install," and "provide" or words with similar meaning shall be interpreted, unless otherwise specifically stated, to mean "furnish and install complete in-place and ready for service."

The work of all trades under this Contract shall be coordinated in such a manner as to obtain the best workmanship possible.

Miscellaneous items and accessories that are not specifically shown on the drawings or specified herein, but which are essential to produce a complete and properly operating installation, or usable structure or plant, providing the indicated function, shall be furnished and installed without change in the Contract price. Such miscellaneous items and accessories shall be of the same quality standards, including material, style, finish, strength, class, weight and other applicable characteristics, as specific for the major component of which the miscellaneous item or accessory is an essential part. The above requirement, however, is not intended to include major components not covered by or inferable from the drawings and specifications.

WELDER QUALIFICATION

Where welding is required on vessels or piping with an ASME P- or S- stamp, qualify welders for welding procedures complying with ASME *Boiler and Pressure Vessel Code*, Section IX. Submit *Welder's Performance Qualification Record* required by the ASME *Boiler and Pressure Vessel Code*.

For piping and structural supports welding, qualify welders in accordance with AWS QC7 *Standard for AWS Certified Welders* for welding procedures complying with ASME B31.1 or ASME B31.9, as applicable. Submit *Welder's Performance Qualification Record* required by ASME B31.1 or B31.9 and a copy of the most recent *Maintenance of Welder Certification* form submitted to AWS.

In addition, submit each welder's assigned number, letter, or symbol used to identify the work of the welder. This symbol shall be stamped in or adjacent to each completed weld.

QUALITY ASSURANCE

The Contract Drawings indicate the extent and general arrangement of the Work. The Contractor shall coordinate the Work under his Contract so as to avoid conflicts between his work and the work of other trades. He shall carefully examine the Drawings and shall be responsible for the proper fitting of materials and equipment into the space provided. If any departures from the Contract Drawings are deemed necessary by the Contractor, detail drawings of such departures and the reasons therefore shall be submitted as soon as practicable to the A-E for his review. No such departures shall be made without this review and written clarification or change order.

If manufacturer recommended details or installation instructions differ from the contract drawings or specifications, then the contractor shall notify the A-E immediately of any discrepancies.

The Drawings and Specifications shall be considered supplementary, one to the other, so that materials and/or labor indicated, called for, or implied by one and not the other shall be provided as though specifically called for in both.

Firestop Materials Codes and Standards: Comply with ASTM Standard E814 and applicable categories of UL's current *Fire Resistance Directory*, Vol. I and II, for compliance with ANSI/UL Standard 1479.

Access Doors Fire-Resistance Ratings: Where fire-resistance rating is indicated for construction penetrated by access units, provide Listed and Labeled units.

OBSERVATION

All work shall be done by skilled technicians, continuously supervised by the Contractor and subject to observation and final acceptance by the A-E. Such final acceptance shall in no way relieve the Contractor from responsibility for defects in either workmanship or material that may subsequently develop.

SUBMITTALS

Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Material and equipment schedules, catalog cuts, manufacturers' data and shop drawings, and field working drawings as required by individual Sections shall be provided.

Shop drawings, technical data and other such submittals required by individual Sections of the Divisions listed above shall be provided.

Equipment drawings, manufacturer's installation instructions as shipped with the equipment, field working and location drawings, wiring diagrams, and coordination drawings shall be provided by the Contractor for items of equipment, sleeves, foundations, curbs, wiring, ductwork, piping, etc., as necessary for information and coordination of all trades. These drawings shall be provided sufficiently in advance of installation to avoid delays and removal and reworking of installed work, and so as to provide information to other trades when and as required. No work shall be done until these drawings have been coordinated by the Contractor.

Submittals shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with Contract requirement. **All submittals shall be accompanied by the "Submittal Cover Form" provided at the end of this Section, signed by Contractor**.

Contractor shall submit complete lists or schedules of all proposed sub-contractors and material suppliers, and of all proposed construction materials and equipment. Materials and equipment lists shall be complete with trade names and/or catalog numbers of each item. Processing of the second and subsequent Certificate for Payment will be withheld until substantial portions of these lists have been submitted.

Products furnished shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer.

Products proposed by the Contractor shall be new except where specifically noted otherwise. Contractor(s) shall provide products only from manufacturers who have published data showing compliance with specified requirements or who certify in writing to such compliance (including laboratory and/or in-place testing, if applicable). All electrical products shall be both labeled and listed, as defined above. **Prior to purchase of major materials, equipment or systems, submit manufacturer's data to the A-E for review as hereinafter specified.**

Products of the specified type and for the specified application offered by the Contractor(s) for use on this Project shall comply with the following requirements:

Product shall have had satisfactory performance in applications of similar character to that specified for a period of at least three (3) years.

Product shall be from an established national or regional manufacturer. The A-E's experience with the manufacturer on prior projects relative to product performance, technical support, etc. may be taken into account to establish suitability of the offered product for this Project.

Product shall be provided through an authorized representative of the manufacturer. The representative shall be capable of providing technical support relative to the installation, operation, and maintenance of the product. The A-E's experience with the representative on prior projects relative to product performance, technical support, etc. may be taken into account to establish suitability of the offered product for this Project.

Repair parts and service for the product shall be available within twenty-four (24) hours of notice.

The manufacturer and his authorized representative shall furnish satisfactory evidence in support of these conditions when requested. The A-E's decision relative to the suitability and acceptability of any product is final and acceptance of this limitation is implicitly acknowledged by the contractor and the manufacturer and/or his representative offering the product for use on this Project.

Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the specifications the submittal shall clearly indicate such deviations by being marked "**NON-COMPLYING FEATURE**." This indication shall be applied to the submittals at the appropriate location in a color contrasting with the remainder of the submittal. Additional information that might assist the Engineer in product evaluation may be included with the submittal. This information should indicate how a specific non-complying feature is believed by the Contractor to meet the intent of the specification.

It is the Contractor's responsibility to demonstrate compliance with the specifications and to clearly indicate any features that do not meet the specifications. It is not the Engineer's responsibility to identify non-compliance. Substantial non-compliance, as determined by the Engineer, is grounds for rejection of the submittal. Discovery of non-complying features that have not been properly identified as such on submittals may require, at any stage of construction, the removal and replacement of the non-complying item(s).

The A-E will review shop drawings, manufacturer's data, and samples with reasonable promptness. This review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve contractor from compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences, and procedures of construction; coordination of his or her Work with that of all other trades; and for performing all work in a safe and satisfactory manner. The Contractor is responsible for any delay caused by his failure to observe submittals requirements and the time for completion of his Contract will not be extended because of such delays.

The A-E's submittals review stamp categories shall be interpreted as follows:

Reviewed: Fabrication and installation or erection may be undertaken.

Exceptions indicated, revise and proceed: Fabrication and installation of erection may be undertaken.

However, Contractor shall comply with all notes or corrections indicated.

Exceptions indicated, revise and re-submit: Neither fabrication, installation, nor erection shall be undertaken. Re-submit corrected copies for review. Corrections shall be limited to items marked, except that changes required in order to coordinate the corrections indicated shall be made. All changes, other than those indicated, shall be called specifically to the A-E's attention.

Rejected, re-submit: Neither fabrication, installation, nor erection shall be undertaken. Revise entire submission to comply with information given in the Contract Documents and re-submit.

Submittals returned to the Contractor with the A-E's "reviewed" or "exceptions indicated, revise and proceed" stamp need not be resubmitted, except that corrected copies of "exceptions indicated, revise and proceed" submittals shall be furnished for record when requested.

Submittals returned to the Contractor with the A-E's "revise and re-submit" or "rejected, re-submit" stamp shall be corrected to comply with Contract requirements and re-submitted to the A-E for review. The Contractor shall direct specific attention, in writing or on re-submitted shop drawings, product data or samples, to revisions other than those requested by the A-E on previous submittals.

Shop drawings of work that involves more than one subcontractor shall be coordinated by the Contractor and submitted to A-E under one cover. No items shall be fabricated, nor any portion thereof shipped to site, prior to receipt by the Contractor of all applicable submittals, including manufacturer's data, samples and shop drawings bearing the A-E's "reviewed" or "exceptions indicated" stamp only.

Manufacturer's data submitted as required by the technical specifications sections or requested by A-E shall consist of four (4) copies of certificates, schedules, catalog cuts, manufacturer's specifications and installation instructions for each type of product or material. Include maintenance recommendations, fire ratings and other reports when applicable to show compliance with the Specifications. When catalog cuts are submitted, the specific item to be considered shall be identified. Items that are not so identified will be returned to the Contractor without action.

Firestop Systems: Submit data on products. Provide manufacturer's certification of UL classification(s) required, including copies of UL systems listings and schedule defining each UL system proposed and the applicable type of penetration.

Access Units: Submit manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions, and directions for installation of anchorage devices.

Contractor shall submit for review any samples required by the technical specification sections or that may be requested by the A-E.

With each electrical testing and compliance submittal, Contractor shall submit evidence of compliance that each manufactured item or component of electrically operated equipment and that each fabricated assembly of electrically operated equipment furnished complies with the testing requirements.

FIRE RATINGS

Fire rating of walls and floors, as indicated on the Drawings, are for reference only. Refer to Architectural Drawings for exact construction and fire ratings.

Where fire resistive insulation or other coverings have been applied to a structural element to obtain a fire rating and this insulation or covering is removed or otherwise disturbed, the Contractor shall be responsible for restoring the material to a condition that matches the original fire protective ability.

USE OF BRAND NAMES

Brand names, scheduled as “basis of design,” are to be considered for information purposes and are not intended to be a product specification.

Where the Contractor proposes to use an item of equipment other than that indicated as basis of design that may require redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required shall be prepared by the Contractor at his own expense and submitted for review by the A-E.

Where such deviation requires a different quantity and arrangement of ductwork, piping, wiring, raceway, or equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and raceway, and any other additional equipment required by the system, at no additional cost.

Brand names, where used as a product specification, are intended to denote the standard of quality required for the particular material or product.

Where the term “equal” or “equivalent” is present, such specification does not restrict the Contractor to a specific brand and equivalent products by other manufacturers may be acceptable. The term "equal" or "equivalent" shall be interpreted to mean a material or product that is similar and equal in type, quality, size, capacity, composition, finish, color, and other performance characteristics to the material or product specified by brand name, and that, **in the opinion of the A-E**, is suitable for the same use and capable of performing the same function as the material or product specified. **Proposed equivalent items must be reviewed by the A-E before they are purchased or incorporated into the work**.

EQUIPMENT SUBSTITUTIONS AND CHANGES/EXTRA COSTS FOR CHANGES IN BUILDING SERVICES

Where the Contractor proposes to use an item of equipment other than that specified or detailed on the Drawings, requiring any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required shall be prepared by the Contractor at his own expense and submitted for review by the A-E.

Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, raceway, or equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and raceway, and any other additional equipment required by the system, at no additional cost.

It is the responsibility of the Contractor to notify the A-E in all cases where the requirements of proposed equipment differ from the requirements specified, shown, or implied on the Drawings or within the Specifications. **Failure of the Contractor to notify the A-E shall not relieve the Contractor of the responsibility of providing compatible equipment at no additional cost as described above**.

OPERATION AND MAINTENANCE DATA

For each Division of the Work, provide four (4) copies of Operating Manuals, Maintenance Manuals, and Test Reports, bound in suitable covers, to the A-E at least two (2) weeks **prior** to the final inspection of the project.

Each manual shall include a cover sheet listing the following:

Project name and location.

Division of Work covered by the manual.
Contractor data, including name, address, phone and fax numbers, and service contact information (24-hour number, email address, etc.)

Date of project completion.

Each manual shall include a table of contents.

Operating manual: Provide all relevant information needed for day-to-day operation and management of the building systems. Include the following for each system:

System Description: Identify the areas of the building the system serves, the locations of performance checkpoints, the expected performance readings at the design load conditions and, where applicable, at part-load conditions. The system's operation during the day, night, and weekend, as well as seasonal start-up and shutdown, safety devices and their function, control devices and their function, pollution control devices, etc., also shall be described. The function of the controls for individual systems shall be described alongside the description of the system function.

Operating Routines and Procedures: Identify activities associated with the normal operation of systems and equipment. Operating checklists and operating logs shall be provided for each system and all performance standards shall be identified.

Seasonal Start-Up and Shutdown: List seasonal start-up and shutdown procedures, including any "mothballing" procedures required.

Special Procedures: Special procedures related to environmental control, health and safety, productive work environment, etc., shall be codified.

Troubleshooting Procedures: This section shall include questionnaires and diagnostics to allow users to isolate probable causes of operating problems in an efficient manner.

Maintenance manual: The maintenance manual shall be divided into two parts:

Part I shall contain information related to the equipment data sheets, nameplate data, operating data, etc. Include the original purchase order number; date of purchase; name, address, and phone number of vendor; and warranty information.

Part II shall support a maintenance program. The manual shall contain information prepared by the equipment manufacturers but shall be supplemented by information provided by the Contractor. Each item of equipment shall be identified, and an individual "Equipment Maintenance Sheet" shall be prepared for each, with the following information:

Description each system and system component, consisting of easily read schematic drawings showing all components, identified to match Part I data, that requires maintenance.

Recommended preventative and predictive maintenance procedures and their recommended frequency of application for each system component.

Recommended list of spare parts with part numbers and place(s) they can be obtained.

Copy of manufacturer's Installation instructions for each component.

Any other information requested by the A/E to support the operation and maintenance of the equipment.

Test reports: Provide copies of the test protocols used in the construction and commissioning of the systems. Arrange data so as to allow the results of ensuing tests to be easily added.

PART 2 - PRODUCTS

MACHINERY DRIVES

V-Belt Drives: Provide ANSI/Rubber Manufacturers Association (RMA) standard or raw edge cogged V-belts with properly selected motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.

The drive shall be rated for the motor horsepower indicated on the Drawings, plus the recommended ANSI/RMA service factor (but, not less than 20%), in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.

Drives 1 horsepower and smaller may be provided with single standard V-belt. Drives 1-1/2 horsepower and larger shall be provided with raw edge cogged V-belts, the number of belts necessary to transmit the required power with 95% minimum efficiency, but in no case less than 2.

Exception: **Belt drives for fans utilized as part of smoke control and/or smoke venting systems shall be rated for the motor horsepower indicated on the Drawings, plus 50% additional service factor, in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact, and shall have at least 2 belts.**

Multiple belts shall be matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.

Sheaves and pulleys shall be fixed pitch type, statically and dynamically balanced, and constructed as follows:

Construction of pressed steel or close-grained cast iron.

Bore shall be fixed or bushing type for securing to shaft with keys.

Groove spacing for driving and driven pulleys shall be the same.

Maximum belt speed shall not exceed 5000 feet per minute.

Minimum motor sheave diameter shall comply with ANSI/RMA recommendations as follows:

Shaft Couplings: Shaft couplings for direct drive equipment driven by polyphase motors shall be flexible type capable of absorbing vibration, rated for the motor horsepower indicated on the Drawings plus an additional 50% service factor. Couplings shall be drop-out type to allow disassembly and removal without removing equipment shaft or motor.

Drive Guards: Drive guards shall be provided for belt drives and shaft couplings.

Belt guards shall comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

Coupling guards shall be constructed steel and comply with ANSI B15.1, Section 8, and OSHA 1910.219. Guards shall be easily removable for access and service and provided with openings for speed checks, etc. without removal.

FIRESTOPPING SYSTEMS

Firestop systems shall be used in locations including, but not limited to, the following:

Penetrations through fire resistance rated floor assemblies and roof assemblies (where required by code) including both empty openings and openings containing penetrants.

Penetrations through fire resistance rated wall assemblies including both empty openings and openings containing penetrants.

Membrane penetrations in fire resistance rated wall assemblies where items penetrate one side of the barrier.

Membrane penetrations in fire resistance rated ceiling assemblies.

Systems or devices must be listed in the UL Fire Resistance Directory and must conform to construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. System must be symmetrical for wall applications.

Systems or devices must be asbestos-free, and all products must be from a single manufacturer.

Products must withstand the passage of cold smoke, either as an inherent property of the system or by the use of a separate product included as part of the UL system or device and designed to perform this function.

Cracks, Voids, or Holes Up to 4" Diameter: Putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, Listed, and capable of expanding 10 times when exposed to flame or heat.

Openings 4" or Greater: Sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350 deg. F (121 to 177 deg. C), Listed.

Wall Boxes:

Metallic boxes used in fire-rated walls or floors must be listed in the UL Fire Resistance Directory under category CEYY.

Listed single and double gang metallic device and outlet boxes with metallic or nonmetallic cover plates may be used in bearing and nonbearing wood stud and steel stud walls with ratings not exceeding 2 hours. The metallic outlet or switch boxes shall be securely fastened to the studs and the opening in the wallboard facing shall be cut so that the clearance between the box and the wallboard does not exceed 1/8 in. The surface area of individual metallic outlet or switch boxes shall not exceed 16 sq. in. The aggregate surface area of the boxes shall not exceed 100 sq. in. per 100 sq. ft. of wall surface.

Metallic boxes located on opposite sides of walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between metallic boxes may be reduced when “Wall Opening Protective Materials” listed in the UL Fire Resistance Directory under category CLIV are installed according to the requirements of the Classification.

Metallic boxes shall not be installed on opposite sides of walls or partitions of staggered stud construction unless “Wall Opening Protective Materials” are installed with the metallic boxes in accordance with Classification requirements for the protective materials.

WALL AND FLOOR ACCESS DOORS

Where floors, walls and ceilings must be penetrated for access to engineering work, provide types of access doors indicated, including floor doors if any. Furnish sizes indicated or, where not otherwise indicated, furnish 24" x 24" panels. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.

Except as otherwise indicated, fabricate wall/ceiling door units of welded steel construction with welds ground smooth, 16-gage frames and 14-gage flush panel doors, 175 deg. swing with concealed spring hinges, flush screw-driver-operated cam locks, factory-applied rust-inhibitive prime-coat paint finish.

Provide rated access doors where installed in fire resistance rated floor and wall assemblies to meet fire rating.

PART 3 – EXECUTION

GENERAL

Comply with NFPA 241, *Standard for Safeguarding Construction, Alterations, and Demolition Operations*; ANSI A10 Series standards for *Safety Requirements for Construction and Demolition*; and Chapter 14 of the *North Carolina State Building Code: Fire Code*.

FIRE PROTECTION DURING CONSTRUCTION

Building contents and all elements of new and/or existing construction must be thoroughly protected from construction procedures that produce sparks, flames, or excessive heat. Such procedures include, but are not limited to, welding, soldering, flame-cutting, using grinders or metal cutting saws, and heating of workspaces. Contractor shall maintain fire watch and/or portable fire-suppression devices, as required, during these operations.

The Contractor shall develop, provide, and post a written plan in compliance with NFPA 241 and Chapter 14 of the *North Carolina State Building Code: Fire Code*.

Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures required to prevent fires and how to deal with them if they occur.

Provide and maintain portable, UL rated fire extinguishers with class and extinguishing agent as required by locations and classes of fire exposures. Comply with NFPA 10 *Standard for Portable Fire Extinguishers.* Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor or area at or near each usable stairwell.

SECURITY AND SAFETY DURING CONSTRUCTION

Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

MOISTURE AND MOLD CONTROL DURING CONSTRUCTION

Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

Protect porous materials from water damage.
Protect stored and installed material from flowing or standing water.

Keep porous and organic materials from coming into prolonged contact with concrete.

Keep roof, wall, and/or openings covered or dammed.

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:

Do not load or install porous materials or components, or items with high organic content, into partially enclosed building.

Keep interior spaces reasonably clean and protected from water damage.

Periodically collect and remove waste containing cellulose or other organic matter.

Discard or replace water-damaged material.

Do not install material that is wet.

Discard, replace, or clean stored or installed material that begins to grow mold.

Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

Controlled Construction Phase of Construction: After completing and sealing of the building enclosure, maintain as follows:

Control moisture and humidity inside building by maintaining effective dry-in conditions.

Use **temporary** HVAC units or system to control humidity.

Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

Hygroscopic materials that may support mold growth that become wet during the course of construction and remain wet for 48 hours are considered defective and must be replaced.

DUST AND CONTAMINATION CONTROL DURING CONSTRUCTION

Prevent dust, fumes, and odors from entering occupied areas or areas in which construction work is more advanced.

Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

Maintain negative air pressure within the work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

Use vacuum collection attachments on dust-producing equipment. Isolate limited work areas using portable dust-containment devices.

Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

Coordinate general construction activities with the work of Divisions 21-28 to avoid contamination and/or degradation of building engineered systems by dust, over-spray of insulation or paint, etc. **Costs for the cleaning and/or component replacement of engineered systems required by contamination and/or degradation by general construction activities shall be assigned to the General Contractor.**

TEMPORARY HVAC SYSTEMS USE DURING CONSTRUCTION

The use of permanent HVAC systems to support construction activities is prohibited. The need for heating, cooling, dehumidification, and/or ventilation during construction shall be met via use of temporary HVAC units or systems as follows:

Heating: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

Cooling: Provide modular, portable stand-alone direct expansion cooling units with condensers vented to the outdoors.

Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

COOPERATION WITH OTHER TRADES

The Contractor shall give full cooperation to other trades and shall furnish any and all information necessary to permit the work of other trades. Information to be provided by the Contractor includes, but is not limited to templates, patterns, setting plans, and shop details as may be necessary for the proper installation of work and for the purpose of coordinating adjacent work. Information required by other trades shall be provided in a timely manner and shall be sufficient to allow the work of such other trades to proceed with the least possible interference or delay.

Where the work of the Contractor will be installed in close proximity to, or may interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. **If the Contractor installs his work before coordination with other trades, he shall make the necessary changes in his work to correct the condition without extra charge.**

MISCELLANEOUS CONCRETE AND STEEL SUPPORTS

All concrete curbs, bases, etc., required for mechanical or electrical equipment and components shall be provided under the Division requiring them except where specifically indicated and/or specified to be provided under a different Division.

"Housekeeping pads", constructed of 3000 psi concrete doweled to floor slab, shall be provided for each floor-mounted component. Pads for air-handling units shall, unless indicated otherwise on the drawings, be 6" high, while pads for all other equipment shall be 4" high. Pads shall be finished smooth with chamfered top edges and corners. Equipment and other floor-mounted elements shall be installed and shall be anchored and grouted to housekeeping pads.

Miscellaneous steel for equipment, pipe, duct, raceway, etc. installation required by the work in any Division shall be provided and placed under that Division except where specifically indicated and/or specified to be provided under a different Division.

Anchors, inserts, supports, attachments, etc., required and but not indicated on the Drawings shall be provided under this Contract.

WIND LOADING

Delegated Design: **Responsibility for the design of manufactured equipment and/or field-fabricated components installed outdoors to withstand wind loading, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of North Carolina, using performance requirements and design criteria hereinafter specified, is delegated to the Contractor.**

Performance Requirements and Design Criteria:

Equipment and/or field-fabricated components installed outdoors as part of Divisions 21-28 Work shall be fabricated and anchored to the ground or building structure, as applicable, to withstand a wind load imposed on the largest vertical or projected surface area, at maximum wind speed by the *North Carolina State Building Code: Building Code* for the Project location, in accordance with ASCE/SEI 7.

Outdoor piping and raceway shall be anchored by using a U-bolt, strap, or other hold-down device anchored at each support point. Equipment and other components shall be anchored by using structural frames, straps, or other hold-down devices anchored to foundations, structural supports, or roof curbs, as applicable.

FIRESTOPPING

Installer should be experienced in installing or applying similar systems, plus: be acceptable to or licensed by manufacturer, state, or local authority where applicable; have at least five years experience; and have successfully completed at least five comparable projects using this system.

Firestop systems or devices installation must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

Install only after substrate penetrations and supporting brackets have been installed. Do not install firestopping when ambient or substrate temperatures are outside limits permitted by manufacturers or when substrates are wet. Where floor openings without penetrating items are more than 4 inches wide and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor. Protect materials on surfaces subject to traffic.

SMOKE-RESISTIVE SYSTEMS

The space around items penetrating non-fire rated walls and floors shall be filled with an approved material to limit the free passage of smoke, heat and flame in locations including, but not limited to, the following:

Penetrations through non-rated floors including both empty openings and openings containing penetrants.

Penetrations through non-rated smoke partitions and wall assemblies including both empty openings and openings containing penetrants.

WALL AND FLOOR ACCESS DOORS

Comply with manufacturer's instructions for installation of access doors, floor doors, and removable access plates.

Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

Adjust hardware and panels after installation for proper operation.

Remove or replace panels or frames that are warped, bowed, or otherwise damaged.

PATCHING

Repair, patching, and finishing of walls, floors, and/or ceilings affected by demolition, cutting after installation of new work, etc. shall be done by technicians skilled in the applicable trades and shall match surrounding or adjoining materials in composition, texture, color, and finish.

CONTRACTOR AS-BUILT DRAWINGS

Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

Accurately record information in an acceptable drawing technique.

Record data as soon as possible after obtaining it.

Record and check the markup before enclosing concealed installations.

Cross-reference record prints to corresponding archive photographic documentation.

Types of items requiring marking include, but are not limited to, the following:

Dimensional changes.

Revisions to details.

Locations and depths of underground utilities.

Revisions to routing of piping and conduits.

Revisions to electrical circuitry.

Actual equipment locations.

Duct size and routing.

Locations of concealed internal utilities.

Additional information that was either shown schematically or omitted from original Drawings.

Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

Submit Contractor As-built Drawings to A/E for review **at least two (2) weeks prior to Project final inspection**.

END SECTION 019913

SUBMITTAL COVER FORM

PROJECT: Governor Morehead School – Building IV HVAC & Generator Renovation
NC Department of Public Instruction

PROJECT NO.: 2023-00583

TO: SALAS O'BRIEN
1620 Midtown Place
Raleigh, NC 27609

FROM: _____

_____

_____

_____

_____ CONTRACTOR _____ SUBCONTRACTOR

We submit for your consideration the following product for the above project:

SPECIFICATION SECTION	SPECIFICATION PARAGRAPH	DESCRIPTION

TYPE OF SUBMITTAL:

_____ Specified Brand Product
_____ Proposed Equivalent Product to Specified Brand
_____ Product Meeting Performance Specification (No Brand Specified)

We warrant the following:

a. We have personally investigated the proposed product, and determined that it is equal in all respects to that specified and/or performance specification requirements;

b. We will provide the specified guarantee for this product;

c. We will coordinate installation of this product into the work, making such changes as may be required for the work to be complete in all respects;

d. We have clearly indicated by marking as "Non-Complying Feature" each and every requirement of the Specifications that this product does not meet;

e. And, we waive all claims for additional costs related to this product which subsequently become apparent.

Attached hereto are complete technical data, including applicable laboratory reports, to demonstrate compliance with project requirements.

SUBMITTED BY:

_____ _____
SIGNATURE DATE

SUBMITTAL REVIEW

(SAMPLE FORM - ORIGINAL WITH COMMENTS WILL BE ATTACHED TO SUBMITTAL BY A/E)

PROJECT:

PROJECT #:

SUBMITTAL ID#:

SPECIFICATION PARAGRAPH:

DESCRIPTION:

Submittal has been reviewed only for conformance with design intent of the contract documents. See Section 019913 "GENERAL REQUIREMENTS FOR ENGINEERED WORK" for complete definition of Submittal Review.

☐ Reviewed

☐ Exceptions Noted - Revise & Proceed

☐ Exceptions Noted - Revise & Resubmit

☐ Rejected

DATE:

BY:

REVIEW COMMENTS:

THESE COMMENTS SHALL NOT BE REMOVED FROM THIS DOCUMENT

SECTION 019916 - WORK IN EXISTING BUILDINGS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to this section.

SUMMARY

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to this section.

The requirements specified herein shall govern all Sections, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

REVIEW OF CONTRACT DOCUMENTS

The Contract Documents may represent imperfect data and may contain errors, omissions, conflicts, inconsistencies, code violations and improper use of materials. Such deficiencies will be corrected by the A-E when identified. The Contractor shall carefully study and compare the individual Contract Documents with each other and report at once in writing to the A-E any deficiencies the Contractor may discover. The Contractor shall require each subcontractor to likewise study the documents and report at once any deficiencies discovered. The Contractor shall resolve all reported deficiencies with the A-E prior to starting any work. **Any work performed prior to receipt of instructions from the A-E will be done at the Contractor's risk.** If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency, or omission in the Contract Documents without such notice to the A-E, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

The Contractor shall be responsible for maintaining habitable structures under this Contract rainproof, and for making equipment and utility installations properly perform the intended function. If he is prevented from so doing by any limitations of the drawings or specifications, the Contractor shall immediately notify the A-E in writing of such limitations before proceeding with construction in the area where the problem or limitation exists.

DEFINITIONS

Electrical Work: Work required by this Contract as defined by specification Divisions 26-28.

Labeled: Appliances, equipment, materials or products to which has been attached a label, symbol, or other identifying mark of an organization acceptable to the North Carolina Building Code Council and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with identified standards or has been tested and found suitable for a specified purpose.

Listed: Appliances, equipment, materials, or products included in a list published by an organization acceptable to the North Carolina Building Code Council and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate designated standards or has been tested and found suitable for a specified purpose.
Concealed: Work within or behind various construction elements or in crawl spaces or trenches that is not exposed to view when the project is complete.

Exposed: Not "concealed" as defined above, or anything exposed to view when the project is complete.

Wiring: Cable, raceways, fittings, mechanical supports, wire, junction boxes, device boxes, outlet boxes, switches, cutouts, and related items.

Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

MATERIALS OWNERSHIP

Unless otherwise indicated, demolition waste becomes property of Contractor. Materials removed during demolition shall be accumulated in the demolition area for examination by the Owner. The Owner may choose to retain selected items. Items not selected to be retained by the Owner become the property of the Contractor and shall be removed from the site in a timely manner. All disposal fees and/or permits shall be the responsibility of the Contractor.

FIELD CONDITIONS

Existing facilities shall remain in use during all phases of construction under this Contract. **All and any of existing building safeties such as exit signage, exit lights, fire alarm, fire sprinkler etc., must remain operational CONTINUOUSLY in order to retain building occupancy status. All required exits and exit signs must be kept available and free of obstruction at all times.** The Contractor shall cooperate with the Owner in every way possible to keep interruption of, and interference with, normal functions, activities, and operations to a minimum.

Where construction or attendant work interrupts normal functions in any area, a schedule of work shall be submitted for approval of the Owner and after approval, strictly followed. Modification to existing work shall be done as required. All work shall be performed in such a manner as to prevent any interruption of any service or utility. Where it is necessary to interrupt service for demolition, cut-in, or changeover, the work shall be scheduled well in advance of the interruption and the interruption approved by the Owner. As required by the Owner, such work shall be done during night, weekends, holidays, or other off-peak period as approved.

Existing piping, ductwork, raceway, and wiring, etc., shall be modified as indicated on the Drawings and/or as required by new and modified construction. Existing piping, ductwork, raceway, and wiring, etc., shall be modified as required and put in first class operating condition. No equipment shall be disconnected without the approval of the Owner's Representative. Temporary relocation of equipment and temporary piping, ductwork, wiring and raceway, etc., required for continued operation of the facility shall be provided as required.

ASBESTOS WARNING

Asbestos and asbestos containing materials are often encountered during the process of renovations or in the performance of site work in or in the vicinity of existing structures. Under no circumstances will the Contractor disturb asbestos or asbestos containing material.

Suspect Materials - Contractor to Notify: It is the Contractor’s responsibility to notify the Owner and the A/E immediately should suspect materials be encountered during construction activities. In the event suspect asbestos or asbestos containing materials are encountered, the Contractor shall immediately cease all work in the area and secure the involved area to prevent inadvertent contamination or exposure. The Owner or the Owner’s agent will conduct testing of suspect materials and notify the Contractor in writing when work in the affected area may resume.

Contractor Responsible for Contamination: The Contractor is enjoined to use extreme caution in the performance of construction activities in the vicinity of asbestos or asbestos containing materials. The Contractor shall bear the total and complete expense, including expenses incurred for decontamination, fines, penalties and incidental expense due to loss of use of the facility resulting from any improper work involving asbestos or asbestos containing materials.

PART 2 - PRODUCTS

GYPSUM WALLBOARD

Interior gypsum wallboard walls or ceilings affected by demolition or new work shall be repaired or patched to match adjacent materials, in compliance with the following:

Gypsum Board: Comply with ASTM C 840 and GA-216.

Joint Treatment Materials: Comply with ASTM C 475.

Joint Tape: Fiberglass.

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

Pre-filling: At open joints, beveled panel edges**,** and damaged surface areas, use setting-type taping compound.

Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use setting-type taping compound.

Fill Coat: For second coat, use drying-type, all-purpose compound.

Finish Coat: For third coat, use drying-type, all-purpose compound.

Where indicated, new GWB walls, partitions, and/or ceilings shall be provided, framed with the following material(s) to match adjacent existing:

Wood framing:

All lumber shall be graded to comply with the rules of applicable grading agencies. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated. Factory mark each piece of lumber with grade stamp of grading agency.

Where nominal sizes are indicated, provide actual sizes for moisture content not to exceed 15 percent. Provide dressed lumber, S4S, unless otherwise indicated.

Provide engineered wood products, as indicated, acceptable to authorities having jurisdiction.

Pressure-treated wood:

Comply with AWPA U1. Use Category UC2 for interior construction not in contact with the ground.

Preservative chemicals shall be acceptable to authorities having jurisdiction and containing no arsenic, inorganic boron, or chromium.

Kiln-dry lumber after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

Fasteners:

Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

Provide fasteners in compliance with the following:

Nails, Brads, and Staples: ASTM F 1667.

Power-Driven Fasteners: NES NER-272.

Wood Screws: ASME B18.6.1.

Lag Bolts: ASME B18.2.1.

Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

Expansion Anchors: Anchor bolt and sleeve assembly of stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

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Metal framing anchors:

Interior Anchors: Fabricate from hot-dip, heavy-galvanized steel sheet complying with ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

Anchors For Use In Wood-Preservative-Treated Lumber: Stainless-steel sheet complying with ASTM A 666, Type 304 for used in indoor treated lumber and Type 316 for use in outdoor treated lumber in coastal regions.
Use for exterior locations and where indicated.

Miscellaneous materials:

Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spun-bonded polyolefin to produce an overall thickness of not less than 0.025 inch.

Metal framing members:

Provide light gauge metal framing shall consist of pre-formed galvanized steel studs and tracks conforming to ASTM C 645 for non-structural steel framing members or to ASTM C 955 for load-bearing steel framing.

Metal framing members shall be manufacturers' standard load-bearing steel studs and joists of type, size, shape, and gauge as indicated. With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, reinforcements, shoes, clip angles, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.

Materials and finishes:

For 16 gauge and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi, ASTM A 446 Grade C.

For 18- and 20-gauge units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi, ASTM A 446 Grade A.

Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.

Finish of installation accessories to match that of main framing components, unless otherwise indicated.

Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

Framing components may be prefabricated into assemblies before erection.

Fabricate panels plumb, square, true-to-line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.

Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.

INTERIOR PAINTING

Where required, provide new interior paint systems to match existing type, thickness, color, and pattern.

Contractor shall verify compatibility of new paint systems which are to be applied over existing systems prior to commencing work. All paints and coatings shall be low VOC types. All color(s) shall match adjacent existing color(s) unless otherwise directed by the A/E.

Work includes painting and finishing of exposed interior items and surfaces, including but not limited to the following:

Building surfaces left exposed after installation or removal of conduit, panels, piping, ductwork, equipment, etc. Any work associated with project work.

Areas of patched/repaired walls, ceilings, and structure.

All coating materials required by this section shall be provided by a single manufacturer, unless otherwise required or approved. Subject to compliance with requirements, provide products by one of the following:

Benjamin Moore & Co.
Duron, Inc.
ICI Paints.
Sherwin-Williams Company (The).

For each individual paint system, provide primer and other undercoat paint produced by the same manufacturer as finish coat.

Painting shall be provided by a firm with not less than 5 years of successful experience in painting work similar in scope to work of this project. Maintain throughout duration of the work a crew of painters who are fully qualified to satisfy requirements of the specifications.

Paint products shall comply with MPI standards indicated below and listed in MPI *Approved Products List*.

Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

Paints and primers shall comply with the following:

Metal Primers:

Rust-Inhibitive Primer (water-based): MPI #107.
VOC Content: E Range of E1.
Environmental Performance Rating: EPR 1.

Waterborne Galvanized-Metal Primer: MPI #134.
VOC Content: E Range of E1.
Environmental Performance Rating: EPR 1.

Latex Paints:

Latex Primer/Sealer: MPI #50.
VOC Content: E Range of E1.
Environmental Performance Rating: EPR 1.

Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).
VOC Content: E Range of E3.
Environmental Performance Rating: EPR 4.5.

Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
VOC Content: E Range of E3.
Environmental Performance Rating: EPR 3.

CARPET

Carpet: Unless indicated otherwise on the Drawings, match adjacent existing carpet tiles or sheet carpeting in type, color, pattern, quality, padding, etc.

Installation Accessories:

Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

MASONRY AND MORTAR MATERIALS

Where required, provide new brick and concrete masonry units to match existing type, size, thickness, color, pattern, etc.

Mortar shall be a pre-mixed, pre-colored cement-lime based mixture formulated to comply with the requirements of ASTM C-270, of type to match existing mortar.

PART 3 - EXECUTION

PERFORMANCE REQUIREMENTS

Comply with governing EPA notification regulations before beginning selective demolition.

Comply with hauling and disposal regulations of authorities having jurisdiction.

EXAMINATION AND PREPARATION

Verify that utilities have been disconnected and capped, valved off, or otherwise secured before starting demolition.

Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate, and measure the nature and extent of conflict. Promptly submit a written report to the A/E.

Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain. As necessary, provide dust barriers, noise control, etc. to minimize the impact of demolition on adjacent occupied areas.

Provide protection to ensure safe passage of people around demolition area and to and from occupied portions of building.

Provide temporary weather protection, during interval between demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

Provide heating, cooling, dehumidification, and ventilation as necessary to protect the existing building materials and finishes during the demolition period.

Where existing plumbing, fire protection, HVAC, or electrical services in demolition areas must be shutdown, temporary plumbing, fire protection, heating, cooling, dehumidification, ventilation, lighting, and electrical power shall be provided as needed to maintain use of adjacent occupied areas that are negatively impacted by the shutdown.

Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

Cover and protect furniture, furnishings, and equipment that have not been removed.

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.

GENERAL CONSTRUCTION DEMOLITION

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:

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, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

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 fire watch and/or portable fire-suppression devices, as required, during flame-cutting operations.

Maintain adequate ventilation when using cutting torches.

Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

Dispose of demolished items and materials promptly.
Protect construction indicated to remain against damage and soiling during demolition.

MECHANICAL DEMOLITION

Remove or relocate all mechanical elements (devices, fixtures, controls, etc.) from walls or floors indicated as being demolished.

Thermostats and sensors containing mercury shall be disposed of in accordance with EPA Resource Conservation and Recovery Act (RCRA). Contractor shall refer to EPA web site for handling procedures for disposal and spill management of projects containing mercury.

Extend or relocate any existing piping and or ductwork serving existing equipment to remain or other items where such circuits are disrupted due to demolition.
Remove all abandoned piping back to the point of supply or back to the point where other remaining piping is connected. For existing piping imbedded existing walls or floors that are not to be demolished, remove piping to behind finish surface, cap, and patch wall or floor as specified hereinafter.

Existing HVAC systems serving both occupied areas and construction areas shall be modified as required to isolate the construction area. Ducts shall be sealed by closing dampers, disconnecting ducts, and sealing openings with 6-mil polyvinyl sheeting, etc.

HVAC equipment in construction areas that is required to be reused shall be de-energized and protected from construction dust and debris with 6-mil polyvinyl sheeting during construction. HVAC systems that are modified during renovation shall be sealed until modifications are made and then resealed until start-up is required. After unsealing of equipment, coils and drain pans of air-handling equipment shall be cleaned.

Recover and recycle refrigerants from existing equipment to be demolished. All demolition work of existing systems containing refrigerant must be conducted in accordance with Section 608 of EPA Clean Air Act under supervision of an EPA certified technician. Provide documentation with types, quantities and dates for the engineers' and owner's record.

Control or monitoring systems that protect equipment and/or occupants must be maintained until associated equipment is removed.

ELECTRICAL DEMOLITION

Coordinate all electrical outages with the Owner to facilitate reworking of existing system. No service, feeder, or branch circuit may be de-energized unless specific approval has been obtained from the Owner's representative.

Dispose of Removed Equipment and Material: Materials removed and not indicated by Drawings to be reinstalled, stored, or retained by the Owner, shall be removed from the site in a timely manner at the Contractor's expense.

The Owner may choose to retain selected items or equipment. The Contractor shall remove and deliver such items and/or equipment to a location on site as requested by the Owner.

Thoroughly inspect electrical systems in reworked areas and bring to the attention of the A-E all defective or unserviceable material not scheduled for removal or replacement.

Remove all abandoned wiring, both exposed and concealed.

Remove all abandoned raceway and any related items, both exposed and concealed. Where existing raceway is concealed in concrete or masonry, remove wiring as required above and abandon in place. Cut abandoned raceway off ½" into wall, ceiling, or floor to allow patching to completely cover cut off end of raceway.

Repair surfaces and finishes to match existing surrounding surfaces or finish in all areas where items are removed. After repairs are made no evidence of previous use of surfaces shall be visible.

Provide touch-up painting as required where new items are installed adjacent to existing items to remain.

Clean new, damaged, and/or disturbed areas and apply primer, intermediate, and finish coats at each location.

Surface preparation and timing of application of successive coats of paint shall be in accordance with paint manufacturer's instructions.

Use zinc-rich paint to repair damage to galvanized finishes. Follow written instructions of the paint manufacturer.

Repair paint finishes for other items, surfaces, or equipment as necessary. Follow written instructions of the paint manufacturer.

Provide blank cover plates to match device plates used in the adjoining areas where outlet, device, junction, or other boxes are to remain,

Perform the electrical demolition as described below:

Remove all electrical raceway, cable, wiring, devices, junction boxes, fittings, and related items from all locations indicated on the Drawings as being renovated. Existing raceway, junction boxes, fittings, and similar items may only be reused for the present project where explicitly indicated on the Drawings, provided:

The existing item is in good condition and is suitable for reuse.

The existing items meet the requirements of the Specifications for similar items which might be provided new in other locations on the project. Additional support and/or fire stopping may be required to meet this condition.

The existing item is located in the same position as required in the new configuration as shown on the Drawings.

Extend or relocate all existing circuits and related items serving existing utilization or other equipment where such circuits or items are disrupted due to demolition activities of any division of the Contract Documents. Relocate all existing junction boxes or similar items that will be rendered inaccessible by new construction furnished under any division of the Contract Documents. Provide any and all temporary electrical supply (supplies) as needed to meet this requirement.

Remove all abandoned circuits back to the point of supply or back to the point where other remaining loads are connected. Label any unused overcurrent devices as "SPARE". Circuits supplying equipment which is removed or demolished by any division of the Contract Documents is considered as "abandoned" for purposes of this requirement.

Revise existing panel directories to reflect modifications made as a part of the project. All directory revisions shall be typed.

INTERIOR PAINTING

Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

Maintain containers in clean condition, free of foreign materials and residue.

Remove rags and waste from storage areas daily.

Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
Examine substrates and conditions for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry. *Beginning coating application signifies Contractor acceptance of substrates and their conditions.*

Preparation:

Comply with manufacturer's written installation instructions and recommendations in MPI *Architectural Painting Specification Manual* applicable to substrates indicated.

Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

Gypsum Board Substrates: Do not begin paint application until the finishing compound is dry and sanded smooth.

Apply paints according to manufacturer's written instructions.

Use applicators and techniques suited for paint and substrate indicated.

Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

Cleaning and Protection:

At the end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

Interior Painting Schedule:

Substrate	Paint System	Prime Coat	Intermediate Coat	Topcoat
Concrete/ Masonry (Non-Traffic Surfaces)	Institutional Low-Odor/VOC Latex: MPI INT 3.1M	Institutional low-odor/VOC interior latex matching topcoat	Institutional low-odor/VOC interior latex matching topcoat	Institutional low-odor/VOC interior latex (flat) (eggshell)
Black Steel	Institutional Low-Odor/VOC Latex: MPI INT 5.1S	Rust-inhibitive primer (water based)	Institutional low-odor/VOC interior latex matching topcoat	Institutional low-odor/VOC interior latex (semigloss)
Galvanized Steel	Institutional Low-Odor/VOC Latex: MPI INT 5.3N	Waterborne galvanized-metal primer.	Institutional low-odor/VOC interior latex matching topcoat	Institutional low-odor/VOC interior latex (semigloss)
Gypsum Wall Board	Institutional Low-Odor/VOC Latex: MPI INT 9.2M	Interior latex primer/sealer	Institutional low-odor/VOC interior latex matching topcoat	Institutional low-odor/VOC interior latex (eggshell)

Painting Completion: After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

CARPET INSTALLATION

Preparation:

General: Comply with manufacturer's written installation instructions for preparing substrates indicated to receive carpet or carpet tile installation.

Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes, and depressions 1/8-inch wide or wider and protrusions more than 1/32-inch unless more stringent requirements are required by manufacturer's written instructions.

Remove coatings, including curing compounds, and other substances on substrates that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

Clean metal substrates of grease, oil, soil, and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

Broom and vacuum clean substrates to be covered immediately before installing carpet.

Installation:

Match adjacent existing carpet installation methods.

Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

Install pattern parallel to walls and borders.

Cleaning and Protection:

Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.

Remove yarns that protrude from carpet tile surface.

Vacuum carpet using commercial machine with face-beater element.

Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

MASONRY UNIT CONSTRUCTION

Only skilled masons who are familiar and experienced with the materials and methods specified shall be used for masonry repair. One skilled mason shall be present at all times during masonry repair and shall personally direct the work.

Deliver materials to site in manufacturer's original unopened containers and packaging, bearing labels as to type and names of products and manufacturers.

Deliver and store material in manufacturer's original, unopened containers with the grade, batch and production data shown on the container or packaging.

Protect materials during storage and construction from wetting by rain, snow, or ground water, and from staining or intermixture with earth or other types of materials.

Protect grout, mortar, and other materials from deterioration by moisture and temperature. Store in a dry location or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing.

Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.

Comply with the manufacturer's written specifications and recommendations for mixing, application, and curing of grouts and patching materials.
Protect persons and building contents from injury or damage resulting from masonry restoration work.

Clean masonry surfaces only when air temperatures are above 40 degrees F and will remain so until masonry has dried out, but for not less than 7 days after completion of cleaning.

Cover partially completed work when work is not in progress.

Protect sills, ledges, projections and surrounding surfaces from mortar droppings.

New Masonry Construction:

Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

Tolerances:

For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.

For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.

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

Lines and Levels:

For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2 inch maximum.

Joints:

For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (, with a maximum thickness limited to 1/2 inch.

For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

For head and collar joints, do not vary from thickness indicated by more than plus 3/8-inch or minus 1/4-inch.

For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thickness and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jams, and, where possible, at other locations.

Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry to match adjacent bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

Built-in Work: As construction progresses, build in items indicated on the Drawings. Fill in solidly with masonry around built-in items.

Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
Lay hollow CMUs as follows:

With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

With webs fully bedded in mortar in grouted masonry, including starting course on footings.

With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.

Allow cleaned surfaces to dry before setting.

Reinforcement: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches. Space reinforcement not more than 16 inches o.c.

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

Lintels: Provide concrete or steel lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels. Provide a minimum bearing of 8 inches at each jamb unless otherwise indicated.

Patching/Repairing Existing Masonry Construction:

Existing Masonry Unit Removal:

Carefully remove by hand masonry units. Cut out full units from joint to joint and in manner to permit replacement with full size units.

Support and protect masonry to remain that surrounds removal area.

Clean remaining masonry at edges of removal areas by removing mortar, dust, and loose debris in preparation for rebuilding.

Masonry Unit Rebuilding:

Match existing coursing, bonding, color, and texture.

Fit replacement units into bonding and coursing pattern of existing. If cutting is required, use a motor driven saw designed to cut masonry with clean, sharp unchipped edges.

Lay replacement masonry with completely filled bed, head and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Do not wet concrete masonry units. Maintain joint width for replacement units to match existing.

Tool exposed mortar joints in repaired area to match joints of surrounding existing masonry.

Repoint new mortar joints in repaired area to match existing mortar joints.

END OF SECTION 019916

SECTION 019919 - EXCAVATION

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to this section.

The requirements specified herein shall govern all Sections, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

SUMMARY

This section address trenching and backfilling for the installation of underground mechanical piping and/or electrical raceway provided under Divisions 21-28.

PROJECT CONDITIONS

Protect property from any and all damage that might result from excavating and backfilling.

Protect persons from injury at excavations, by barricades, warnings, and illumination.

Coordinate excavations with weather conditions, to minimize possibility of washouts, settlements and other damage and hazards.

PART 2 - PRODUCTS

DIRECT BURY WARNING TAPE

Tape shall be 0.004 inch thick, 6 inches wide, yellow polyethylene with a ferrous metallic core, acid and alkali-resistant and shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elongation factor of 350 percent. Provide bold black letters on the tape identifying the type of system. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

PART 3 - EXECUTION

TREE CONSERVATION

Provide a fenced tree protection area around all trees within the excavation area. **In no case shall excavation take place within the outmost edge of branches above, referred to as the "drip line".** Fencing shall be constructed of metal poles with orange plastic barricade or wood tree protecting fencing. Every 50 linear feet of tree protection fence shall have a sign that says “Tree Protection Fence” using 3” minimum height black letters on white background. At least one sign is required.

No materials, equipment, or people may enter into the tree protection area. Allow no poisoning to trees with the dumping of materials such as solvents, gas, paint, and herbicides or with the washing of toxic materials into the tree protection area. Exercise care that no runoff from clean up operations (including concrete clean up wash water) enters the tree protection areas.

Where required excavation occurs in the immediate vicinity of a tree protection boundary, work shall proceed in the following manner: Prior to grading or digging in the critical root zone of protected trees, root prune the tree to avoid the ripping of roots with digging equipment. This may be accomplished with a trencher. Any roots larger than ½" that are damaged due to cut grading or trenching operations must be stubbed cleanly.

EXCAVATION SUPPORT AND PROTECTION

Furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

Shore, support, and protect utilities encountered during excavation.

Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

EXCAVATION FOR UTILITY STRUCTURES

Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. As required, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections. Do not disturb bottom of excavations intended as bearing surfaces.

At edges of tree- and plant-protection zones, excavate by hand to indicated lines, cross sections, elevations, and sub-grades. Use narrow tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

EXCAVATION FOR UTILITY TRENCHES

Do not excavate for electrical work until the work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimized.

Excavate trenches to indicated gradients, lines, depths, and elevations.

Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit.

Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

Provide 12 inches clearance on each side of pipe or conduit unless indicated otherwise.

Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.

For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.

Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

For trenches in tree- and/or plant-protection zones, hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

STORAGE OF SOIL MATERIALS

Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

TRENCH ROCK

For purposes of determining rock removal payments trench rock shall be defined as **any subsurface material, including abandoned concrete foundations and pavement, encountered during trench or pit excavation operations which cannot be excavated and loaded out by a 2 cubic yard capacity hydraulic backhoe.**

The Contractor shall include in his contract the cost of providing the above listed equipment whenever he encounters any subsurface material which he intends to claim as trench rock. **If said equipment can successfully remove the material in question, there will be no removal payments allowed.**

> Explosive blasting is generally not allowed. If extreme rock conditions are encountered a blasting alternative must be approved by the A-E.

Measurements for the determination of actual quantities of rock removed shall be confined the limits below. There will be no quantities of rock allowed in excess of these limits.

> Equipment Pads and Pits: 1’-0” beyond the plan dimension of the exterior limits of the equipment to be installed.
>
> Trenches: 1’-6” greater than the width of the raceway or duct bank to be installed, projected vertically. 6” below the depth of the raceway or duct bank when same is installed to the minimum cover requirements as stated in the Specifications or on the Drawings, whichever is larger.

DEWATERING

Prevent surface water and ground water from entering excavations. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

BACKFILL

Place backfill on sub-grades free of mud, frost, snow, or ice.

Backfill voids with satisfactory soil while removing support and protection systems.

Trench backfill:

Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (% of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.

Lawn/Landscaped Areas: 85% for cohesive soils; 90% for cohesionless soils.

Paved Areas, Other Than Roadways: 90% for cohesive soils; 95% for cohesionless soils.

Roadways: 90% for cohesive soils; 95% for cohesionless soils.

Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.

Do not backfill trenches until tests and inspections have been made and backfilling authorized by A-E. Use care in backfilling to avoid damage or displacement of piping, conduit, etc.

Place and compact bedding course on trench bottoms as indicated on the Drawings. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

Install warning tape directly above utilities, 12 inches below finished grade. See Sections 221125 and 221126 for special underground gas piping identification requirements, as applicable.

RESTORATION OF EXTERIOR IMPROVEMENTS

Exterior improvements damaged or removed as part of excavation shall be repaired/replaced as follows:

Turf and Grasses:

Provide turf and grasses, as follows, by either seeding or sodding as indicated on the Drawings:

Seeding: Utilize Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

Loosen sub-grade to a minimum of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and construction debris. Lime surface and apply fertilizer directly to subgrade before loosening. Fertilizer shall be commercial grade providing 1 lb/1000 sf of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to match existing grassed areas, roll and rake, remove ridges, and fill depressions to match adjacent finish grades.

Moisten prepared area before planting, as required.

Apply grass seed as follows:

Sow seed with a spreader or seeding machine at a rate of 3-4 lb/1000 sf.

Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with a fine spray.

Protect seeded areas with 1:4 slope or greater with erosion-control blankets installed in accordance with manufacturer's requirements.

Protect seeded areas with less than 1:4 slope with straw mulch. Spread mulch evenly to yield a continuous 1-1/2-inch-thick blanket.

Apply turfgrass sod as follows:

Lay sod within 24 hours of harvesting.

Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

Lay sod across angle of slopes exceeding 1:3. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples, spaced as recommended by sod manufacturer, but not less than 2 anchors per sod strip to prevent slippage.

Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

Asphalt Paving:

Apply dense, hot-laid, hot-mix asphalt plant mixes designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types." Paving thickness shall be as follows:

Base Course: Dept of existing paving, minus 2 inches.

Surface Course: 2 inches.

Provide mixes with a history of satisfactory performance in the geographical area where Project is located.

Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515 for the following nominal, maximum aggregate sizes:

Base Course: 1 inch.

Surface Course: 1/2 inch.

Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

Apply tack coat uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

Apply herbicide according to manufacturer's recommended rates and written application instructions to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course. Offset longitudinal joints, in successive courses, a minimum of 6 inches. Offset transverse joints, in successive courses, a minimum of 24 inches.

Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement. Compact asphalt at joints to a density within 2 percent of specified course density.

Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

Complete compaction before mix temperature cools to 185 deg F.

Compact each course to produce the thickness indicated within the following tolerances:

Base Course: Plus or minus 1/2 inch.

Surface Course: Plus 1/4 inch, no minus.

Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

Base Course: 1/4 inch.

Surface Course: 1/8 inch.

Crowned Surfaces: Test with crowned template centered and at right angle to crown. The maximum allowable variance from template is 1/4 inch.

Concrete Paving:

Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

When automatic machine placement is used, determine design mixtures, and obtain laboratory test results that meet or exceed requirements.

Proportion mixtures to provide normal-weight concrete with compressive strength (28 Days) of 4000 psi.
Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

Coordinate joint types, descriptions, and locations with Drawings. Construction, isolation, and contraction joints and edging have been consolidated in this article for consistency rather than for strict sequence of installation.

Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

At butt joints, use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

Locate expansion joints at intervals of 50 feet.

Install joint fillers full width and depth of joint. Place top of joint filler flush with finished concrete surface.

Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

Before placing concrete, inspect and complete formwork installation, steel reinforcement,] and items to be embedded or cast-in.

Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation.

Screed paving surface with a straightedge and strike off.

Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

For concrete curbs and gutters, use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

Comply with ACI 306.1 for cold-weather protection.

Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

Installation of concrete shall comply with tolerances in ACI 117 and as follows:

Elevation: 3/4 inch.

Thickness: Plus 3/8-inch, minus 1/4 inch.

Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/2 inch.

Joint Spacing: 3 inches.

Joint Depth: Plus 1/4 inch, no minus.

Joint Width: Plus 1/8 inch, no minus.

Unit Paving:

Brick pavers shall be solid, paving brick complying with ASTM C902. Color, thickness, size, texture, and finish shall match existing pavers or shall be selected by the A/E.

Concrete pavers shall be solid interlocking paving units complying with ASTM C 936 and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates with a compressive strength not less than 5000 psi. Size and shape, thickness, color, texture and finish shall match existing pavers or shall be selected by the A/E.

Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

For concrete pavers, a block splitter may be used.

Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

Joint pattern shall match and continue existing unit paver joint pattern.

Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or required slope, for finished surface of paving.

Provide edge restraints to match existing. Install edge restraints before placing unit pavers.

Where pavers set in mortar bed are required as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.

Provide steps made of pavers as indicated. Install paver steps before installing adjacent pavers.

Retain subparagraph below and detail on Drawings if pavers set in mortar are used as steps with aggregate-set pavers.

Where pavers set in mortar bed are indicated for steps constructed adjacent to pavers set in aggregate setting bed, install steps, and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

Pavers shall be laid with aggregate or mortar setting-bed materials to match existing.

Provide/install aggregate setting-bed materials as follows:

Sub-base and base aggregates shall be sound, crushed stone or gravel complying with ASTM D 2940.

Stone screenings for leveling course shall be sound stone screenings complying with ASTM D 448 for Size No. 10.

Sand for joints shall be fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16. sieve and not more than 10 percent passing No. 200 sieve.

Compact soil subgrade uniformly to at least 95 percent of ASTM D 1557 laboratory density.

Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, and replace with compacted backfill or fill as directed.

Place aggregate sub-base and base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth to match existing.

Place leveling course and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant, and density is loose and uniform until pavers are set and compacted.

Treat leveling course with herbicide to inhibit growth of grass and weeds.

Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.

Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

Do not allow traffic on installed pavers until sand has been vibrated into joints.

Repeat joint-filling process 30 days later.

Provide/install mortar setting-bed materials as follows:

Dry mortar mix shall consist of Portland cement complying with ASTM C 150, Type I or II; hydrated lime complying with ASTM C 207, Type S; and sand complying with ASTM 144.

Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

Apply mortar-bed bond coat over surface of concrete sub-base about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch thickness for bond coat.

Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch-) thick bond coat to mortar bed or to back of each paver with a flat trowel.

Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/8 inch.

Spread dry sand and fill joints.

Repeat joint-filling process 30 days later.

DISPOSAL OF SURPLUS AND WASTE MATERIALS

Remove surplus soil and waste materials, including unsatisfactory soil, trash, and construction debris, and legally dispose of them off Owner's property.

END OF SECTION 019919

SECTION 019926 - OWNER INSTRUCTION AND TRAINING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to this section.

The requirements specified herein shall govern all Sections, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

QUALITY ASSURANCE

The Owner instruction and training program shall be developed and coordinated by a firm or individual experienced in training or educating maintenance personnel.

Contractor personnel experienced in the systems and components incorporated in this Project, along with factory-authorized service representatives, shall perform the instruction.

COORDINATION

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.

Coordinate content of training modules with content of manufacturers' recommended emergency, operation, and maintenance procedures.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Instructional Program and Instructional Materials: Submit detailed description of instructional program structure, training modules, and instructional materials.

Instructor Qualifications: Submit curriculum vitae for each instructor, specifically defining the experience of each instructor and the training modules for which he or she shall be responsible.

PART 2 - PRODUCTS

INSTRUCTION PROGRAM

General: **The Contractor(s) for each of Divisions 21-28, as applicable, is responsible for instructing Owner's personnel relative to each Division's work**, including the following:

Instruction in the operation of systems, subsystems, and equipment.

Training in maintenance of systems, subsystems, and equipment.

Program Structure: Develop an instruction and training program that includes individual training modules for each Division 21-28 system, subsystem, and equipment item, including both classroom instruction and "hands-on" demonstrations.

Training Modules: Develop a learning objective and teaching outline for each instruction and training module, taking into consideration the level of proficiency of Owner's maintenance staff. Include a description of specific skills and knowledge that each participant is expected to master.

For each instruction and training module, include instruction for the following, as applicable to the system, subsystem, equipment, or component:

Documentation: Review the following items in detail:

Operations manuals.

Maintenance manuals.

Project record documents.

Warranties, bonds, and guarantees.

Maintenance service agreements and similar continuing commitments.

Emergencies: Include the following, as applicable:

Instructions on meaning of warnings, trouble indications, and error messages.

Shutdown instructions for each type of emergency.

Operating instructions for conditions outside of normal operating limits.

Sequences for electric or electronic control systems.

Special operating instructions and procedures.

Operations: Include the following, as applicable:

Startup procedures.

Equipment or system break-in procedures.

Routine and normal operating instructions.

Regulation and control procedures.

Control sequences.

Safety procedures.

Normal start-up and shutdown instructions.

Operating procedures for emergencies.

Operating procedures for system, subsystem, or equipment failure.

Required sequences for electric or electronic control systems.

Special operating instructions and procedures.

Adjustments: Include the following:

Alignments.

Routine adjustments, tightening, etc.

Noise and vibration adjustments.

Economy and efficiency adjustments.

Maintenance: Demonstrate the following:

Inspection procedures.

Preventative maintenance requirements, consisting of the following:

Routine maintenance, which consists of specific procedures that are performed on a regular schedule and are designed to detect, preclude, or mitigate degradation of a system or its components.

Predictive maintenance, which uses routine inspection and evaluation, testing, and analysis to augment routine maintenance procedures by detecting the onset of component degradation and to address problems as they are identified.

Instruction on use of special tools.

Repairs: Include the following:

Troubleshooting and diagnostic instructions.

Test and inspection procedures.

Repair instructions.

Disassembly; component removal, repair, and replacement; and reassembly instructions.

Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

Owner will furnish an instructor to describe Owner's operational philosophy.

Owner will furnish Contractor with names and positions of participants to attend instruction and training.

Confirm Topics and Agenda with owner prior to scheduling.

Provide instruction at mutually agreed times scheduled at least four (4) weeks in advance through the A/E. For systems, subsystem, and/or equipment that requires seasonal operation, provide required instruction at start of each season.

Conduct training on-site in the completed and fully operational facility in classroom/conference space provided by the Owner and using the actual systems, subsystems, and equipment installed.

Conduct training using final operation and maintenance data submittals as the training reference material. If additional training materials are utilized, they shall be incorporated as an appendix to the operation and maintenance data submittals.

END OF SECTION 019926

SECTION 230210 – HVAC SUMMARY OF WORK

Engineer of Record for Heating, Ventilating, and Air-Conditioning work is Chris Cagle, PE, Salas O'Brien, 1620 Midtown Place (27609), P. O. Box 19944, Raleigh, NC 27619. Heating, Ventilating, and Air-Conditioning work shall be defined by drawings numbered with the prefix "H-", the general provisions of the Contract including General Conditions and Supplementary Conditions, Division 1 Specification sections, and Division 23 Technical Specification sections listed below. In addition, Heating, Ventilating, and Air-Conditioning work may be defined by reference to other documents by any of the above-named sources as well as by project addenda.

DIVISION 23 - HVAC TECHNICAL SPECIFICATIONS

Section	Title
230210	HVAC Summary of Work
230510	HVAC Basic Requirements
230511	Electrical Provisions for HVAC Work
230513	Electrical Motors for HVAC Equipment
230517	Sleeves and Sleeve Seals for HVAC Piping
230529	Hangers and Supports for Piping, Ductwork & Equipment
230593	HVAC Testing, Adjusting, and Balancing
230596	HVAC Systems Commissioning
230713	HVAC Duct Insulation
230719	HVAC Piping Insulation
232113	Above-Ground Hydronic Piping
232300	Refrigerant Piping
233100	HVAC Ductwork
233300	Air Duct Accessories
238116	Ductless Split System Air-Conditioning Units
238120	Packaged Water-Cooled Heating and Cooling Units
238216	Air Coils

END OF SECTION 230210

SECTION 230510 – HVAC BASIC REQUIREMENTS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

The requirements specified herein shall govern all Sections in Division 23, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Submit Welder's and Brazer's Qualifications. Welders' and Brazers' Qualifications: Operators who are to do the welding and/or brazing must be properly qualified to do satisfactory work. **Proof of an operator's qualifications shall be either the Contractor's record of suitable tests passed within the preceding six months while in the employ of the Contractor, or tests made before the start of work.** Submit qualification data for each operator prior to their starting work. Any workman considered by the A-E as not having the skill necessary for the work shall be required to pass an appropriate qualification test or shall be at once barred from further welding and/or brazing on the project.

EQUIPMENT SELECTION

Pump heads and fan static pressures indicated on the Drawings are for estimating purposes and are based on the individual equipment losses as indicated. If the Contractor proposes using equipment, components, pipe or duct routing, etc. that will increase the pump heads and/or fan static pressures, any required pump or fan changes, along with associated motor and power wiring changes, shall be at the Contractor's expense.

TEMPERATURE AND HUMIDITY CRITERIA

Indoor temperature and humidity conditions in occupied spaces, unless specifically specified or indicated otherwise on the Drawings, shall be maintained as follows:

Space/ Area	Indoor Air Condition	Occupied Periods	Unoccupied Periods
General occupied spaces	Dry Bulb Temperature	70-77 deg F	55 deg F, Minimum 85 deg F, Maximum
	Relative Humidity	30-60% RH	65% RH Maximum

ACOUSTIC CRITERIA

Outdoor HVAC equipment shall be selected, located, and oriented to limit the "Equivalent Sound Level" (LA_{eq},T) A-scale sound pressure level (dBA), averaged over T=16 hours, to 50 dBA or less at the site boundary or at a distance of 100 feet, whichever is closer to the equipment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

PIPING WELDING/BRAZING/SOLDERING

High Pressure Piping (above 15 Psig):

Refrigeration piping systems shall be fabricated, assembled and welded/brazed/soldered in accordance with the ASME B31.5.

Non-Destructive Inspection and Testing: A/E shall visually inspect pipe welds. Based on visual inspections, upon order of the A/E, non-destructive testing of selected pipe welds shall be performed by a qualified testing agency, at the expense of the Owner, using one of the following methods selected by the A/E. The welds inspected shall be selected randomly, but the selection shall include an examination of welds made by each welding operator or welder.

Radiographic testing in accordance with ASTM E 94:

Make identification of defects by comparing radiographs to reference radiographs in ASTM E 390.

Film shall positively and properly identify as to member being inspected, location of weld, and location of film on weld.

Stamp identification on steel so film may be easily identified and matched to identification mark.

Ultrasonic testing in accordance with ASTM E 164:

Size of defects will be determined by relating amplitude of oscilloscope traces to hole in ASTM reference weldment.

Diameter of reference holes shall be 3/32-inch.

Weld defects which are cause for rejection include cracks, lack of fusion, incomplete penetration, porosity, or slag inclusions which produce reflections equal to or greater than 80 percent of reference hole reflection and have linear dimensions as indicated by transducer movement exceeding 1/4-inch for material thickness up to and including 3/4-inch.

Correction of Defective Welds: If random testing reveals that **any welds** fail to meet minimum quality requirements, an additional 10 percent of the welds in that same group shall be inspected at the Contractor's expense. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds inspected also fail to meet the quality requirements, that entire group of welds shall be rejected. At the Contractor's option, the rejected welds shall be removed and the joints rewelded or the rejected welds shall be 100 percent tested as hereinbefore specified and all defective weld areas removed and rewelded.

OPERATION OF HVAC SYSTEMS

HVAC equipment, subsystems, and/or systems may be started and temporarily operated as necessary to perform the work, testing, balancing, and/or verification as specified in various sections of Division 23. Air systems shall be started **only** after general construction activities in the areas served by the air systems are such that there is low risk of contamination and/or degradation to the system. Generally, the following construction status is required within the entire area served by an individual air system:

Floor/wall/ceiling preparation that requires sanding or other dust producing work is complete.

Wall/ceiling surfaces required to be painted shall at least have one coat of primer applied.

Ceiling spray-on decorative or acoustical coatings, where specified, are complete.
Dust-producing outdoor (site) work has been completed.

During temporary operation of air systems, the following additional measures are required:

Filters shall be installed in fan coil units, air handling units, etc., as specified in Sections 234113 and 234123, as applicable.

Install temporary roll media filters (minimum MERV 13) over each air inlet (return or exhaust). Temporary filters shall be replaced regularly in order to minimize pressure losses impose on fans.

Windings of open, drip proof electric motors shall be cleaned using low pressure compressed air at the end of each 72 hours of operation.

Once HVAC systems verification has been completed, air systems shall be shut down, temporary filters removed, and air handler filters replaced with new unless specifically directed otherwise by the A-E. **Only upon receipt of written approval by the A-E shall HVAC systems be placed into final service prior to Substantial Completion of the Project.**

END OF SECTION 230510

SECTION 230511 - ELECTRICAL PROVISIONS FOR HVAC WORK

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

The requirements specified herein shall govern all Sections in Division 23, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

DESCRIPTION OF WORK

Work includes, but is not necessarily limited to the following:

Provide electrical heating coils and similar elements in mechanical equipment.

Provide motor starters for furnished equipment where starters are required for the intended application when **not provided under Division 26**. Starters shall be sized in accordance with the latest edition of the National Equipment Manufacturers Association (NEMA) standard ratings for magnetic starters, and the *National Electrical Code* (NEC).

NEMA Starter Sizes for Motors					
NEMA Starter Size	Maximum HP for System Voltage (V)/ Phase (PH)				
	120V/1PH	240V/1PH	208V/3PH	240V/3PH	480V/3PH
00	1/3	1	1-1/2	1-1/2	2
0	1	2	3	3	5
1	2	3	7-1/2	7-1/2	10
2	3	7-1/2	10	15	25
3	7-1/2	15	25	30	50
4	-	-	40	50	100

Provide disconnect switches for all furnished equipment. Disconnect switches shall be sized in accordance with the latest edition of the NEC for single motor applications as follows:

Disconnect Switch Sizes for Motors						
Switch Rating Amps (A)	Maximum HP at System Voltage (V))/ Phase (PH)					
	120V/1PH	208V/1PH	240V/1PH	208V/3PH	240V/3PH	480V/3PH
30A	1-1/2	3	3	5	7-1/2	15
60A	3	7-1/2	10	15	15	30
100A	5	10	10	25	25	60
200A	-	-	-	50	60	100
400A	-	-	-	100	125	250
600A	-	-	-	150	200	400

Disconnect switches shall be sized for all other applications based on total kW rating of the equipment as follows:

Disconnect Switch Sizes for Equipment							
Switch Rating Amps (A)	Maximum kW at System Voltage (V)/ Phase (PH)						
	120V/ 1PH	208V/ 1PH	240V/ 1PH	277V/ 1PH	208V/ 3PH	240V/ 3PH	480V/ 3PH
30A	2.8	5.0	5.8	6.6	8.6	10.0	19.9
60A	5.8	10.0	11.5	13.3	17.3	19.9	39.9
100A	9.6	16.6	19.2	22.2	28.8	33.2	66.4
200A	19.2	33.3	38.4	44.3	57.6	66.4	132.9
400A	38.4	66.6	76.8	88.6	115.1	132.9	265.7
600A	57.6	99.8	115.2	133.0	172.7	199.3	398.6

Dual element fuses shall be provided with disconnect switches. Fuses shall be sized based on the nameplate rating for the equipment.

Equipment enclosures for disconnect switches, starters, variable frequency drives, control panels and any other panel enclosures housing electrical equipment shall be rated based on NEMA standard ratings. Panel enclosures shall be suitable for the environment in which they will be installed. Unless noted otherwise, provide NEMA rated enclosures based on the following environment conditions:

NEMA Enclosure Ratings for Electrical Equipment	
NEMA Type	Environment Condition
1	Indoors only, dry, low dust, and non-corrosive environment
3R	Outdoors, weatherproof and rainproof
4	Outdoors, watertight and raintight
4X	Same as 4 plus corrosion resistant
7	Hazardous locations Class I, Groups A, B, C, or D
9	Hazardous locations Class II, Groups E, F, or G
12	Indoors subject to circulating non-hazardous dust, or dripping non-corrosive liquids

Provide all single phase interlock and control wiring required for sequenced operation of mechanical devices provided for mechanical systems under Division 23. Under Divisions 26-28, a source of power for these devices shall be provided and extended to the devices under Division 23.

Make all power wiring connections for mechanical equipment as recommended by the equipment manufacturer. Under Divisions 26-28, power wiring to the line side of a disconnecting provided and installed under Division 23 will be provided.

> Some items of equipment may require conductor and/or raceway combinations different from the supply conductors provided under Division 26-29 to the equipment disconnect; coordinate and provide connections as recommended by the equipment manufacturer.

Division 23 Contractor is responsible for providing and installing fuses in disconnects that supply Division 23 utilization equipment.

Provide any required power wiring not specifically shown on the electrical drawings (E-Sheets) or specified in Divisions 26-28.

QUALITY ASSURANCE

Coordination with Electrical Work: Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Divisions 26-28 sections. Comply with requirements of applicable Divisions 26-28 sections for raceways and wiring methods associated with final electrical connections to equipment installed under this Division.

Standards:

For electrical equipment and products, comply with applicable NEMA standards and refer to NEMA standards for definitions of terminology herein.

Comply with NFPA 70, *National Electrical Code* (NEC) for workmanship and installation requirements.

Comply with NFPA 70E, *Standard for Electrical Safety in the Workplace*, while performing any electrical work. **(NFPA 70E is referenced in OSHA 29CFR Part 1910, Subpart S, Appendix A, and is considered by OSHA as the industry practice for electrical safety.)**

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for electrical materials and products.

Source Limitations: Provide motor starters, combination motor starters, and disconnects through one source from a single manufacturer.

PART 2 - PRODUCTS

MOTOR STARTERS

Motor Starters: Provide surface-mounted, heavy duty, steel enclosed motor starters with NEMA size rating, voltage rating, and current rating based on the tables provided in Part 1 of this specification.

Motor starters are three pole types. Starters shall be rated as follows unless otherwise specified:

For 120/240 V.: Use 250 Volt type

Provide full voltage, non-reversing magnetic motor starters with auxiliary control devices as indicated.

Provide units with RMS symmetrical fault withstand rating suitable for application, but no less than 22,000 amps. Design of units shall ensure that faults will be contained within the starter enclosure.

Running Overload Protection: Equip with thermal overload protection device for each motor circuit.

Auxiliary Contacts: Provide two sets of normally open auxiliary contacts and two sets of normally closed auxiliary contacts.

Provide additional **sets** of normally open and/or normally closed auxiliary contacts is such are required to accomplish control functions as defined by the drawings or required by specified control and interlock sequence(s).

Provide additional sets of contacts as required to operate pilot lights as described elsewhere. Contacts required to operate pilot lights are **not shown on the Drawings**. Contacts required to operate pilot lights are to be furnished at no additional cost.

Accessories on Cover: Provide the following accessories on the combination starter cover.

Reset Pushbutton

Hand-Off-Automatic (HOA) Switch

Push to Start Switch

Pilot Lights on Cover: Pilot lights are to be transformer types, configured to operate from the same voltage as the motor starter coil. Provide the following pilot lights on the starter cover.

Red Pilot Light, illuminated when starter is energized

Green Pilot Light, illuminated when starter is not energized

Disconnect Auxiliary Contacts: Provide 2 pole disconnect auxiliary contacts for control circuits where control circuits are provided from a separate electrical source.

Coils: Provide starters with operating coils for 120 volts.

Control Transformer: Provide control transformer having a primary voltage rating to match the line-to-line voltage of the motor supplied by the starter and a secondary voltage to match the voltage of the starter coil. Size control transformer to supply the starter and all pilot devices supplied with a 25% reserve capacity for additional pilot devices.

Provide NEMA-rated enclosure type suitable for its environment as required by Section 230511.

COMBINATION MOTOR STARTERS

General: Combination starters may be used in lieu of separate disconnect and motor starter. Provide surface-mounted, heavy duty, steel enclosed combination motor starters meeting requirements described for motor starters. Provide combination motor starters with NEMA size rating, voltage rating, current rating, and number of poles indicated on the Drawings.

Circuit Breakers: Provide factory-assembled, molded-case circuit breakers with permanent instantaneous magnetic trips in each pole, with fault-current interrupting rating suitable for application and ampere ratings as indicated. Circuit breaker ratings must be clearly visible when the compartment door is open without the necessity of removing operating mechanisms or similar items to obtain visibility. Where adjustable circuit breakers are provided, such adjustments must be also be readily accessible once the compartment door is opened. Provide push-to-trip feature for testing and exercising circuit breaker trip mechanism. Construct breakers for mounting and operating in any physical position and in ambient temperature of 40° C. Provide with AL/CU rated screw type removable connector lugs. Field coordinate all circuit breaker sizes with equipment nameplate ratings prior to purchase.

Disconnect Operators: Provide external operator handles for circuit breakers. Design handle with up-down motion and with down position indicating “OFF." Combination Motor Starters with rotary type circuit breaker operators are not acceptable. Construct handles which permit locking handle in “ON” or “OFF” position with a hasp-type padlock.

Provide two-pole interlock switches for all disconnects that are used with utilization equipment requiring control connections provided from separate electrical sources. The interlock switch is to be configured such that when the disconnect is open the interlock switch is open.

Provide additional interlock switches, auxiliary contacts, plumbing key interlocks, or other accessories as may be described by the Drawings.

Provide NEMA-rated enclosure type suitable for its environment as required by Section 230511.

CIRCUIT AND MOTOR DISCONNECTS

Safety Switches: Provide surface-mounted, heavy duty, steel enclosed safety switches, of types, voltage rating, current rating, and number of poles indicated in this Section.

Switches with no drawing indication of number of poles are three pole types. Switches shall be fusible type, rated as follows unless otherwise specified:

For 120/240 V.: Use 250 Volt type, with neutral and grounding bus.

Where a neutral is not provided to the specific utilization equipment served, the neutral bus can be bonded to the enclosure and used as a grounding bus.

Provide horsepower rated switches incorporating quick-make, quick-break type switches constructed so that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable. Internal current carrying components shall be high-conductivity copper; switch contacts shall be silver-tungsten type. Fuse holders shall have positive pressure type reinforced fuse clips. Where non-fused disconnect switches are indicated, provide solid copper bus bars in lieu of fuses.

Provide NEMA-rated enclosure type suitable for its environment as required by Section 230511.

Provide switches that may be locked in either the “ON’ or ‘OFF’ condition with a 1/4" shackle hasp-type lock. Safety switches shall have door interlocks that prevent the door from opening when the operating handle of the switch is in the “on” position. Manual defeat mechanisms shall be provided for the interlocks.

Provide two-pole interlock switches for all disconnects that are used with utilization equipment requiring control connections provided from an alternate power source. The interlock switch is to be configured such that when the disconnect is open the interlock switch is open.

Provide additional interlock switches, auxiliary contacts, mechanical key interlocks, or other accessories as described by the Drawings.

For all outdoor equipment, provide a fused weatherproof disconnect switch, sized and fused in accordance with manufacturer's requirements.

Fuses shall be furnished by the Contractor. Fuses shall be current limiting type with a minimum AIC rating of 100,000 AMP. The contractor shall furnish Owner with one complete set of spare fuses at the completion of the project.

PART 3 - EXECUTION

GENERAL

Coordinate the exact location of all equipment disconnects to ensure that disconnects are located within sight of mechanical equipment.

Extend power wiring circuits from load side of termination points provided under Divisions 26-28 to each item of mechanical equipment requiring electrical power. All wiring shall be installed in raceway. All wiring and raceway shall be in compliance with Division 26. Utilize liquid tight flexible metallic conduit for weatherproof for outdoor locations. Provide all necessary clamps, fitting, connectors, raceways, circuit conductors, etc., for a completely operational system.

INSTALLATION OF CIRCUIT AND MOTOR DISCONNECTS

Install disconnects as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation," and in accordance with recognized industry practices.

Coordinate placement of disconnects with electrical raceway and cable work, as necessary for proper interface. Coordinate exact location of disconnects with equipment electrical connection point.

Locate disconnects so that they are readily accessible after all project elements are installed. Location selected for disconnects must permit complete opening of the door or cover to the maximum amount permitted by the design of the switch enclosure.

Install disconnects for use with motor-driven appliances and motors within sight of the controllers, as indicated on the Drawings. In addition, each motor shall be provided with an approved disconnecting device within sight of the respective equipment as required by the NEC even though not specifically indicated on the Drawings. Disconnects installed for use with controllers may serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.

INSTALLATION OF STARTERS

Install starters as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation," and in accordance with recognized industry practices.

Coordinate placement of starters with electrical raceway and cable work, as necessary for proper interface. Coordinate exact location of starters with equipment electrical connection point.

Locate starters so that they are readily accessible after all project elements are installed. Location selected for starters must permit complete opening of the door or cover to the maximum amount permitted by the design of the switch enclosure.

GROUNDING

Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for electrical combination motor starters. All combination starters shall be grounded by means of a separate insulated grounding conductor, run with the ungrounded conductors, and bonded to the starter enclosure by means of a dedicated grounding screw terminal or bus.

FIELD QUALITY CONTROL

Subsequent to completion of installation of disconnects and motor starters, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.

OWNER INSTRUCTION AND TRAINING

Provide Owner instruction and training.

END OF SECTION 230511

SECTION 230513 - ELECTRICAL MOTORS FOR HVAC EQUIPMENT

PART 1 – GENERAL

RELATED DOCUMENTS

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

The requirements specified herein shall govern all Sections in Division 23, whether stated therein or not.

Where items specified in the other sections of this Division conflict with requirements of this Section, the former shall govern.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for products specified in this Section.

PART 2 - PRODUCTS

MOTOR CHARACTERISTICS

Motors shall be rated for continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

Capacity and torque characteristics shall be sufficient for motor to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or service factor.

Unless otherwise noted in the documents, Motors 1 hp and above shall be polyphase, suitable for electrical service indicated on the Drawings. Fractional horsepower motors shall be single phase, rated for operation at 120 V.

All motors shall meet the NEMA Premium™ Efficiency Standards.

All electric motor efficiencies shall comply with energy efficiency requirements of Code of Federal Regulations Title 10, Chapter II, Part 431, Subpar B “Electric Motors”.

SINGLE PHASE MOTORS

Constant speed motors larger than 1/20 hp and less than 1 hp shall be one of the following, to suit starting torque and requirements specified above:

- Permanent-split capacitor.
- Split phase.
- Capacitor start, inductor run.
- Capacitor start, capacitor run.

Constant speed motors 1/20 hp and smaller shall be shaded-pole type.

Two-speed motors shall be variable-torque, permanent-split-capacitor type.

Variable speed motors shall be electronic commutation motors (ECM), brushless DC motors with internal circuitry to convert AC power supplied to DC power to operate the motor. Motor shall be speed-controllable via internal circuitry down to 20% of full speed (i.e., 80% turndown) via 0-10 VDC or 4-20 mADC controller output signal from the building direct digital control system. Motor shall be a minimum of 85% efficient at all speeds.

Bearings shall be prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

PART 3 - EXECUTION

GENERAL

Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 HP and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

END OF SECTION 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data, including installation instructions for each type of sleeve and sleeve seal product. Submit expansion compensation schedule showing Manufacturer's figure number, size, location, and features for each required expansion compensation product.

PART 2 - PRODUCTS

SLEEVES

Cast-Iron Pipe: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

Black Steel Pipe: ASTM A 53, Schedule 40, with plain ends and welded steel collar.

Galvanized Sheet Metal: Factory-fabricated of G90 galvanized sheet metal with lock-type longitudinal seam, minimum 18 ga.

SLEEVE-SEAL SYSTEMS

Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

Pressure Plates: Stainless steel.

Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

GROUT

Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

Characteristics: Nonshrink; recommended for interior and exterior applications.

Design Mix: 5000-psi, 28-day compressive strength.

Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

SLEEVE AND SLEEVE-SEAL APPLICATIONS

Use sleeves and sleeve seals for the following piping-penetration applications:

Penetration Application	Sleeve Type	Sleeve Seal Required
Exterior walls above grade	Cast Iron	Yes

SLEEVE INSTALLATION

Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

Cut sleeves to length for mounting flush with both surfaces.

> Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

Install sleeves for pipes passing through interior partitions. Cut sleeves to length for mounting flush with both surfaces and install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 019913.

SLEEVE-SEAL-SYSTEM INSTALLATION

Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

SLEEVE-SEAL-FITTING INSTALLATION

Install sleeve-seal fittings in new walls and slabs as they are constructed.

Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

Secure nailing flanges to concrete forms.

Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 230517

SECTION 230529 – HANGERS AND SUPPORTS FOR PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc. Standard Compliance: Comply with MSS SP-58 *Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation* for pipe hangers and supports.

SMACNA Compliance: Fabricate and install ductwork hangers and supports in accordance with *HVAC Duct Construction Standards - Metal and Flexible*.

ASTM Compliance: Structural steel elements utilized for piping, ductwork, or equipment support shall comply with ASTM A 36.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

PART 2 - PRODUCTS

GENERAL

Hangers and supports for HVAC piping, ductwork, and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

Structural support elements shall be fabricated from standard structural shapes complying with ASTM A 36 and/or from preformed channel struts.

Preformed channel struts shall be 1-5/8 inches wide by height required to meet load capacities and designs indicated on the drawings. Strut shall be made from steel meeting the minimum mechanical properties of ASTM A653 SS, Grade 33, G90 galvanized. Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A907 SS, Grade 33. All fittings and hardware shall be zinc plated in accordance with ASTM B633, SC3 for fittings and SC1 for threaded hardware. Channel members shall be "Unistrut", Allied Support Systems "Power Strut", or Cooper B-Line Systems, Inc. "Strut System", specifically sized in accordance with the criteria hereinbefore specified.

Building attachments for hangers and supports shall be as indicated on the Drawings. Where attachments are not

indicated, they shall be as follows:

Attachment To	Attachment Method(s)
Hollow Walls	Bolt to slotted steel channels fastened to wall with expansion anchors.
Wood Structural Members	Install bolts through members.

PIPE HANGERS AND SUPPORTS

General: Piping systems shall be classified in accordance with MSS SP-58, as follows:

Classification	Temperature Range (deg F)	Typical Service Applications
Type 3: Cold Systems	Type 3A: 32-70	Cooling Condensate Drains
	Type 3B: <32	Liquid And Cold Gas Refrigerant

Horizontal Pipe Hangers: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers complying with MSS SP-58, of the following MSS types listed, to suit horizontal-piping systems:

Adjustable Steel Clevis Hangers: MSS Type 1 for Classification Type 3 piping.

Trapeze Pipe Hangers: Trapeze hangers shall be field-fabricated from structural steel members or from preformed channel members and suspended by all-thread hanger rods; weld steel, as required, in accordance with AWS standards. Each pipe on a trapeze hanger shall be individually supported as follows:

Adjustable Pipe Saddle: MSS Type 36 with adjustable support Classification Type 3 piping.

Copper Pipe Saddle: Copper-plated or -coated steel.

Insulation Protection: Provide MSS Type 40 insulation shield for Classification Type 3 piping at each pipe support.

DUCT HANGERS AND SUPPORTS

Ductwork hangers shall be fabricated of sheet metal straps in accordance with SMACNA's *HVAC Duct Construction Standards - Metal and Flexible* or of all-thread rod.

EQUIPMENT HANGERS AND SUPPORTS

Floor-Mounted Equipment: Floor-mounted equipment shall be installed on housekeeping pad in accordance with Section 019913 and as specified above.

Suspended Equipment: For suspended equipment, the Contractor shall provide structural steel framing to distribute the imposed operating loads without stressing building structural elements or causing damage to the building substrate. Weld steel in accordance with AWS standards.

PART 3 - EXECUTION

INSTALLATION OF PIPE HANGERS AND SUPPORTS

Use only one hanger type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation for insulated piping.

Arrange for grouping of parallel runs of horizontal suspended piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings and all-thread hanger rods sized in accordance with the following:

Nominal Pipe Size (in.)	Max. Span for Copper Tubing (ft.)	Max. Span for Steel Pipe (ft.)	Min. All-Thread Hanger Rod Size (in.)
<1	5	7	3/8
1 to 1-1/4	6	7	3/8
1-1/2	8	9	3/8
2	8	10	3/8
2 -1/2	9	10	1/2
3	10	12	1/2
4	10	12	5/8
6	10	12	3/4
8-12	10	12	7/8
14	10	12	1
18-20	10	12	1-1/4
24	10	12	1-1/2

Rigid plastic piping (ABS, PVC, CPVC, etc.) shall be suspended with adjustable band pipe hangers, MSS Type 10, with factory-fabricated, welded-in support shield. Maximum hanger spacing for rigid plastic pipe shall be 50% of the maximum span allowed for steel piping.

Hangers and supports for piping shall be attached to the building structure; **attachment to roof deck or cross-bracing is prohibited; attachment to other piping, ductwork, or equipment is prohibited. The use of wire or perforated strap hangers is prohibited.**

Pipes are to be supported within 3’ of any coil connection.

INSTALLATION OF DUCT HANGERS AND SUPPORTS

Hang or support metal ductwork in accordance with Section 5 of SMACNA's *HVAC Duct Construction Standards - Metal and Flexible*. Where multiple ducts are supported by a common trapeze hanger, the trapeze shall comply with Table 5-3.

Suspend flexible ducts in accordance with SMACNA's HVAC *Duct Construction Standards - Metal and Flexible*, Figures 3-10 and 3-11.

Hangers and supports for ductwork shall be attached to the building structure; **attachment to roof deck or cross-bracing is prohibited; attachment to other ductwork, piping, or equipment is prohibited. The use of wire or perforated strap hangers is prohibited.**

INSTALLATION OF EQUIPMENT HANGERS AND SUPPORTS

Floor-mounted equipment shall be installed level and plumb on housekeeping pads in accordance with Section 019913 and in accordance with the manufacturer’s requirements.

Suspended equipment shall be supported by structural steel members or preformed channel struts with all-thread rod hangers. As required, vibration isolations required by Section 230548 shall be installed between the supports and the hangers. Suspended units shall be installed level and plumb and supported in accordance with the manufacturer’s requirements.

Hangers and supports for equipment shall be attached to the building structure; **attachment to roof deck or cross-bracing is prohibited; attachment to ductwork, or piping is prohibited. The use of wire or perforated strap hangers is prohibited.**

END OF SECTION 230529

SECTION 230593 – HVAC TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK

Extent of testing, adjusting, and balancing (TAB) work is includes, but is not necessarily limited to, duct systems and associated equipment and apparatus of HVAC work.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Certification: Submit TAB subcontractor certification.

Instrument Calibration Report: Submit calibration test results for balancing instruments.

TAB Reports: Draft and final test reports

QUALITY CONTROL

TAB work shall be completed by an independent balancing subcontractor certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

GENERAL

After systems have been started up and initially adjusted, the Contractor shall perform tests and accomplish the balancing necessary to provide the air and water flows indicated on the Drawings.

TAB subcontractor shall spot check systems with A/E at Final Inspection.

CERTIFIED TEST REPORTS

General: Four copies of the Draft Test and Balance Reports shall be provided to the A/E before the Final Inspection. The reports shall comply with reporting procedures defined in Chapter 13, ASHRAE Standard 111 and as hereinafter specified.

After the A/E check of the system at or before the Final Inspection, the Final Test and Balance Reports shall be provided to the A/E. **Additionally, one copy of the Final Test and Balance Report shall be submitted to the authority having jurisdiction and a copy shall be included with each copy of the Operating and Maintenance Manuals.**

Certification: Both Draft and Final Reports shall be certified by the TAB subcontractor and shall:

Be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards.

Accurately represent how the systems have been installed.

Define how the systems are operating at completion of the TAB procedures.

Draft Reports: Upon completion of TAB procedures, prepare and submit draft reports for review by the A/E. Draft reports may be hand written, but must be complete, factual, and legible. Organize and format draft reports as hereinafter specified.

Final Reports: After review and verification by the field check by the A/E of the Draft Report, submit the Final Reports, organized and formatted as hereinafter specified.

Reports Format: Bind report forms complete with schematic systems diagrams and/or plans and other referenced data in reinforced, vinyl, three-ring binders.

Provide title page listing the name, address, and telephone numbers of the TAB subcontractor. Provide list of all test instruments utilized, along with last date of calibration.

Provide certification page, signed by the TAB project manager, as hereinbefore specified.

Divide contents of the binder into the following divisions, as applicable, separated by divider tabs:

General Information and Summary

Air Systems TAB

Reports Contents:

System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

Quantities of supply and return flows.

Flow and/or Flow Balancing stations.

Location and position of balancing devices (valves, dampers, etc.)

Design Data and Test Results: For each HVAC component and system, provide design data and final adjusted test data, including but not limited to the following:

Component Data	Test Data (Design and Final Adjusted Values)
Air-Handling Units	
Identification	Air flow rate in cfm
Location	System static pressure in inches wg
Manufacturer	Fan rpm.
Manufacturer model number and unit size	Discharge static pressure in inches wg.
Manufacturer's serial number	Filter static-pressure differential in inches wg
Unit arrangement and class	Preheat-coil static-pressure differential in inches wg
Discharge arrangement.	Cooling-coil static-pressure differential in inches wg
Fan sheave make, size in inches and bore.	Heating-coil static-pressure differential in inches wg
Center-to-center dimensions of sheave, and amount of adjustments in inches	Outdoor airflow in cfm Return airflow in cfm
Number, make, type, and size of drive belts	Outdoor-air damper position
Number, type, and size of filters	Return-air damper position
Motor make, and frame type and size.	Outdoor-air, wet- and dry-bulb temperatures in deg F
Motor Horsepower and rpm.	Return air, wet- and dry-bulb temperatures in deg F

Component Data	Test Data (Design and Final Adjusted Values)
Motor volts, phase, and hertz Motor Full-load FLA and service factor Motor sheave make, size in inches and bore	Vortex damper position Coils: See requirements below
Electric Heating Coil	
Identification. Location. Coil identification. Capacity in kW. Number of stages. Connected volts, phase, and hertz. Rated FLA. Air flow rate in cfm Face area in sq. ft.. Minimum face velocity in fpm	Heat output in kW Air flow rate in cfm Air velocity in fpm Entering-air temperature in deg F Leaving-air temperature in deg F Coil voltage at each connection. Coil amps for each phase.
Air Terminal Device (Register, Grille, Diffuser, etc.)	
System and air-handling unit identification Room/area served Number from system diagram. Manufacturer Type and manufacturer's model number. Size (face and neck) Effective area in sq. ft.	Test method Design air flow rate in cfm Design air velocity in fpm Preliminary measured air flow rate in cfm Preliminary measured velocity in fpm Final air flow rate in cfm Final velocity in fpm Space temperature in deg F
Condensing Unit	
Identification Location Manufacturer Manufacture model number and serial number Nameplate rated capacity Compressor(s): Number/type of compressors Refrigerant Nameplate data for each compressor including capacity and rated electrical data. Fans: Number/type of fans Motor(s) horsepower and rpm Motor(s) FLA and service factor	Entering air temperature in deg. F Leaving air temperature in deg. F Air flow rate in cfm High side refrigerant pressure in psig at each compressor Low side refrigerant pressure in psig at each compressor Compressor and fan motor(s) voltage at each connection Compressor and fan motor(s) amps for each phase

TEST AND BALANCE PROCEDURES

Test Instruments Calibration: Instruments for air and water test and balance shall have been calibrated within a period of six months prior to balancing and tested for accuracy prior to start of work. Calibrate vibrometer utilized for vibration testing before each day of testing using calibrator provided with the meter. Calibrate sound meters before each day of testing using calibrator complying with ANSI S1.40 and NIST certification.

Air Systems Test and Balance Procedures:

General: Air handling and distribution systems, including supply and return ariflows shall be balanced and adjusted in accordance with Chapter 10 of ASHRAE Standard 111 and Section 7.2.2 of ASHRAE Standard 62.1. Maximum air quantities at each outlet or inlet shall not vary more than -5% to +10% from those indicated on the Drawings.

A/E QUALITY CONTROL CHECK

In the presence of the A/E during or before the Final Inspection, the TAB subcontractor shall verify the balance of the air and water systems as follows:

Each air handler will be checked for proper airflow by an anemometer traverse on the entering side of the cooling coil..

At least 15% of registers, grilles, and diffusers will be checked for proper air flow via calibrated flow hood..

The TAB subcontractor shall provide all test instruments required for the Owner/Engineer check of the air and systems balance.

During the A/E check, the TAB contractor shall verify the full range of air flows for the items selected to be checked. The Contractor shall have the controls sub-contractor present during the A/E check of the air systems balance.

END OF SECTION 230593

SECTION 230596 – HVAC SYSTEMS COMMISSIONING

PART 1 – GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

GENERAL

HVAC systems commissioning shall be performed by the Contractor and shall include the following:

Establish a commissioning "team" consisting of the installing personnel, the controls subcontractor, and the testing, adjusting, and balancing (TAB) subcontractor(s).

Systematically evaluate all installed HVAC components, equipment, subsystems, and systems to ensure that they are working in accordance with this design documents. This includes measuring temperatures and flow rates from all HVAC devices and calibrating all sensors to a known standard.

Perform commissioning procedures, equipment functional performance tests, and tests of the sequences of operations to verify that the controls are providing the correct interaction between equipment, subsystems, and systems.

PART 2 – DESIGN INTENT

GENERAL

The contract documents define the requirements for HVAC components, equipment, subsystems, and systems, along with the control requirements for each element. It is the intent of the Designer that all HVAC components, equipment, subsystems, and systems shall perform in accordance with the stipulated requirements through the entire operational range of each element, while satisfying temperature, humidity, air quality, acoustic, and vibration criteria defined in Section 230510.

SEQUENCES OF OPERATION

Sequences of operation shall be as indicated on Drawings.

PART 3 – FUNCTIONAL PERFORMANCE

SYSTEMS START-UP

Appendix 230596 outlines basic start up and check out requirements for HVAC systems and equipment. Generally these procedures are the direct responsibility of the Contractor as a basic element of validating that the installation is correct. These items provide a minimum or guideline for development of start up procedures, checklists and tests along with the general requirements indicated above (that are common to all). **Contractor shall synthesize these requirements with that of the manufacturer's and/or applicable codes and standards to develop specific and itemized start up procedures specific to that installed on this project.**

FUNCTIONAL PERFORMANCE TESTS AND CERTIFICATION

Functional performance tests shall be performed in accordance with the checklists in Appendix 230596 to prove all modes of the sequences of operation and to verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. **The checklist shall then be repeated until it has been completed with no errors.**

Functional performance tests shall begin only after all work and testing required in related specification sections have been successfully completed, after all pre-commssioning checks have been successfully completed, after the control systems are fully functional, after the testing, adjusting, and balancing work has been completed and after all test and inspection reports and operation and maintenance manuals required have been submitted and reviewed by the A/E.

APPENDIX 230596 – HVAC SYSTEMS COMMISSIONING CHECKLISTS

Section	Component
232300	Refrigerant Piping Systems

START-UP CHECKS

Confirm that piping is adequately supported and vibration isolation is addressed in accordance with Sections 230529 and 230548.

Confirm that piping has been painted and that piping and valves have been labeled in accordance with Section 230553.

Confirm that refrigerant piping is complete in accordance with Section 232300 and drawings. Confirm that system has been evacuated, charged, and pressure tested in accordance with Section 232300. Provide leak test report.

Make sure that refrigerant lines are insulated in accordance with Section 230719 and supported in accordance with Section 230529 and 230548.

Confirm that service valves are accessible.

FUNCTIONAL PERFORMANCE TESTS

Confirm that refrigerant pressures and temperatures comply with associated equipment requirements.

Section	Component
238120	Packaged Condensing Units

START-UP CHECKS

Evaluate air-cooled unit location: are clearances adequate to prevent air short cycling? If not, what modifications are required to ensure proper unit operation?

Confirm that refrigerant piping is complete in accordance with Section 232300 and the design drawings. Confirm that system has been evacuated, charged, and pressure tested in accordance with Section 232300. Provide leak test report.

Check to ensure:

Service valve caps are installed and tightened.

Test voltage and compare with design data.

Ensure that all factory and field wiring connections are tight.

Confirm that the indoor (evaporator) fan is on the correct speed tap.

Confirm that unit is painted and labeled in accordance with Section 230553.

START-UP PROCEDURES

Energize crankcase heater (as applicable) for 8 hours before starting the unit.

Close the electrical disconnect to energize the system.

Set the thermostat system switch to OFF.

Set the thermostat to a temperature below indoor ambient conditions.

Set the control system so that unit will cool. Operate unit for 15-20 minutes, then check refrigerant charge.

Adjust refrigerant charge in accordance with the manufacturer's instructions and repeat start-up procedures.

If the condensing unit is designed for heat pump duty, repeat the above tests setting the control system so that unit will heat.

FUNCTIONAL PERFORMANCE TESTS

Start air handler to provide load for condensing unit. Activate controls system start sequence as follows.

Start air handling unit. Verify control system energizes condensing unit start sequence.

Shut off air handling equipment to verify condensing unit de-energizes.

Restart air handling equipment one minute after condensing unit shut down. Verify condensing unit restart sequence.

Verify condensing unit amperage each phase and voltage phase to phase and phase and compare to design and TAB data.

Record the following information and compare to design and TAB data:

Ambient dry bulb temperature (degrees F)
Ambient wet bulb temperature (degrees F)
Suction pressure (psig)
Discharge pressure (psig)

Confirm correct operation of hot gas bypass (as applicable).

Describe and document any unusual vibration, noise, etc.

Section	Component
238120	Packaged Heating and Cooling Units

START-UP CHECKS, START-UP PROCEDURES, AND FUNCTIONAL PERFORMANCE TESTS

Confirm that units are installed in accordance with specifications and design drawings.

Ensure condensate drains properly and that trap is adequate.

Turn unit control to system-on position. Unit fan should be on.

Turn unit ventilation air control to off position.

Turn unit control to cooling position or set unit thermostat 10°F below space temperature.

Measure unit discharge air after unit is in cooling position for at least 5 minutes. This air should be below 60°F. The cooling coil should show condensation if the space dew point is over 50°F.

Turn unit control to heating position or set unit thermostat 10°F above space temperature. If hydronic heating system is used for the system, make sure the specified hot water temperature is available.

Measure unit discharge air after unit is in heating position for at least 5 minutes. This air should be above 100°F.

Measure unit airflow and compare to design and TAB data.

Measure motor current and compare to motor nameplate data.

Measure the fan static pressure and compare to design data.

END APPENDIX 230596

SECTION 230713 - HVAC DUCT INSULATION

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Flame/Smoke Ratings: Provide composite duct insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 225) method.

> Exception: Outdoor HVAC ductwork insulation may have flame spread index of 75 and smoke developed index of 150.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

Samples: Submit, as requested by A-E, manufacturer's sample of each duct insulation type required. Affix label to sample completely describing product.

PART 2 - PRODUCTS

INSULATION MATERIALS

Mineral Fiber Insulation: Insulation made up of fibers manufactured of glass, rock, or slag, processed from the molten state, with or without a binder.

> Mineral Fiber Blanket Insulation: ASTM C 553, Type II, with factory-applied jacket. Insulation density shall be 1.00 pcf and conductivity, k, tested in accordance with ASTM C 518 or C 177 at 75ºF mean temperature shall not exceed 0.27 Btu-in./(hr-sf-ºF).
>
> Factory-Applied Jacket for Mineral Fiber Insulation: Jacket and tape shall comply with ASTM C 1136, Type II, as follows:
>
> > FSP Jacket: Jacket consisting of aluminum foil, fiberglass-reinforced scrim with polyethylene backing.
> >
> > FSK Jacket: Jacket consisting of aluminum foil, fiberglass-reinforced scrim with kraft-paper backing.
> >
> > Jacket Tape: Seams and tears/damage to jacket shall be sealed with foil-face, vapor-retarder type tape matching the factory-applied jacket, with acrylic adhesive, 3" wide, and not less than 6.5 mils thick.

PART 3 - EXECUTION

INSULATION APPLICATION

Indoor ductwork shall be insulated as follows:

Concealed ductwork shall be insulated with 2” thick mineral fiber blanket insulation.

Insulate the following ductwork and plenums:

Supply air, including back side of air outlets
Return air

Exceptions: Do not insulate the following:

Flexible connections at fans or equipment
Factory-insulated flexible ductwork

GENERAL INSTALLATION REQUIREMENTS

Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

Install insulation with longitudinal seams at top and bottom of horizontal runs.

Install multiple layers of insulation with longitudinal and end seams staggered.

Keep insulation materials dry during application and finishing.

Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

Install insulation with least number of joints practical.

Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

Install insulation continuously through hangers and around anchor attachments. Extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

Install insulation with factory-applied jackets as follows:

Draw jacket tight and smooth.

Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket.

Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c. Tape laps with 3" wide foil tape.

For below ambient services, apply vapor-barrier mastic over staples.

Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal. Apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

INSTALLATION OF MINERAL FIBER INSULATION

Blanket Mineral Fiber Insulation Installation: Secure with adhesive and insulation pins, as follows:

Apply adhesives according to manufacturer's recommended coverage rates per unit area of duct and plenum surfaces.

Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts. **Adhesive secured pins are prohibited.** Pins shall be installed as follows:

On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

Do not overcompress insulation during installation.

Impale insulation over pins and attach speed washers.

Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface.

Cover exposed pins and washers with 3" long piece of 3" wide foil continuous vapor barrier tape.

For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface.

Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

EXISTING INSULATION REPAIR

Repair damaged sections of existing duct or plenum insulation damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 225) method.

> Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific.

Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

Samples: Submit, as requested by A-E, manufacturer's sample of each piping insulation type required. Affix label to sample completely describing product.

PART 2 - PRODUCTS

PIPING INSULATION MATERIALS

Cellular Glass Insulation: Pre-formed sections of foamed or cellulated glass with annealed, rigid, hermetically sealed closed cells in accordance with ASTM C 552, Type II, Class 2, factory-jacketed.
Closed Cell, Flexible Elastomeric Insulation: Flexible elastomeric, closed cell, thermal insulation in accordance with ASTM C534, Type I, preformed tubes, black in color, rated for piping temperatures to 220 degrees F. Insulation shall be AP/Armaflex or equivalent.

PART 3 - EXECUTION

PIPING SYSTEM INSULATION APPLICATIONS

Piping systems shall be classified in accordance with MSS SP-58, as follows, and be insulated as hereinafter specified:

Classification	Temperature Range (deg F)
Type 3: Cold Systems	Type 3A: 32-70
	Type 3B: <32

Classification Type 3A Piping: Insulate the following cold HVAC piping systems:

Cooling coil condensate drain piping.

Insulate indoor piping with cellular glass insulation, 2" thick for pipe sizes up to and including 4",

Exceptions:

Indoor Type 3A piping 1" NPS and smaller may be insulated with 1” thick flexible elastomeric insulation.

Classification Type 3B Piping: Insulate the following cold HVAC piping systems:

Refrigerant suction lines between evaporators and compressors.

Exceptions:

Indoor Type 3B piping 1" NPS and smaller and condensate drains may be insulated with 1” thick flexible elastomeric insulation.

GENERAL INSTALLATION REQUIREMENTS

For Classification Type 3 piping, install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

Insulate pipe elbows using preformed fitting insulation or mitered sections made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

Install removable insulation covers for valves and piping specialties and where indicated on the Drawings.
Installation shall conform to the following:

Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

Design and Construction: The covers shall be designed to fit tightly to the component and fabricated in one piece whenever possible (including bonnet cover being attached to the valve body cover). Jacket will be sewn inside-out and then turned correct side out before inserting the insulation core. Gussets will be separate pieces sewn to the inner (hot face) and the outer (cold face) jacket surfaces to provide a thermal break.

Install insulation accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state. Install insulation with longitudinal seams at top and bottom of horizontal runs.

Install multiple layers of insulation with longitudinal and end seams staggered. Do not weld pins, clips, or other insulation attachment devices to piping, fittings, and specialties.

Keep insulation materials dry during application and finishing.

Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

Install insulation with least number of joints practical.

Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

Install insulation continuously through hangers and around anchor attachments:

At pipe hangers and supports, protect the insulation from compression as follows:

Piping Classification Type 3 shall be insulated with cellular glass piping insulation for the length of the insulation shield specified in Section 230529. Insulation vapor barrier shall be lapped and sealed in accordance with manufacturer’s instructions to maintain continuous vapor barrier integrity.

Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

Install insulation with factory-applied jackets as follows:

Draw jacket tight and smooth.

Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket.

Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

For below-ambient services, apply vapor-barrier mastic over staples.

Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Outdoor piping shall be covered by vapor barrier and exterior (weatherproofing) jacket as soon as possible after the insulation has been installed. All polyisocyanurate and/or polystyrene materials applied in one day shall have their vapor barrier installed the same day. Any exposed insulation shall be temporarily protected with a combination moisture and UV barrier (such as 6 mil black polyethylene film) to keep out moisture. Mastics shall not be applied with the ambient air temperature is below 40° F or is expected to be below 40° F within 24 hours of the application.

INSULATION INSTALLATION AT PENETRATIONS

Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

Seal penetrations with flashing sealant.

For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

Seal jacket to wall flashing with flashing sealant.

Interior Wall, Partition, and Floor Penetrations: Install insulation continuously through walls, partitions, and floors. Seal penetrations through fire-rated assemblies complying with requirements of Section 019913 for firestopping and fire-resistive joint sealers.

INSTALLATION OF CELLULAR GLASS INSULATION

Insulation Installation on Straight Pipes and Tubes:

Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs.

Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

Insulation Installation on Pipe Flanges:

Install preformed pipe insulation to outer diameter of pipe flange.

Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch and seal joints with flashing sealant.

Insulation Installation on Pipe Fittings and Elbows:

Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

Insulation Installation on Valves and Pipe Specialties:

Install preformed sections of cellular-glass insulation to valve body.

Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

Install insulation to flanges as specified for flange insulation application.

INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

Flexible elastomeric insulation shall be installed in strict accordance with the manufacturer's written installation instructions.

Insulation Installation on Straight Pipes and Tubes:

Install un-slit insulation sections to the maximum extent possible. Seal butt joints with manufacturer's recommended adhesive.

Where slit insulation sections must be used, seal longitudinal seams and butt joints with manufacturer's recommended adhesive. **Secure slit sections on both sides of each fitting and 12" o.c. on straight pipe or tubing runs with 2" wide, 1/8" thick insulation tape matching the adjacent insulation. The use of metal bands, plastic bands, and wire are prohibited.**

Insulation Installation on Pipe Flanges:

Install pipe insulation to outer diameter of pipe flange.

Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

Insulation Installation on Pipe Fittings and Elbows:

Fabricate mitered sections of pipe insulation as fitting covers.

On soldered, brazed, or buttwelded joint fittings, insulation that fits the adjacent piping may be used.

For screwed or socket weld joint fittings, the insulation inside diameter shall match the outside diameter of the adjacent piping. Fitting covers shall lap adjacent piping insulation by at least 1".

Secure insulation materials and seal longitudinal seams and butt joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

Insulation Installation on Valves and Pipe Specialties:

Install preformed valve covers manufactured of same material as pipe insulation when available.

When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

Install insulation to flanges as specified for flange insulation application.

Secure insulation to valves and specialties and seal longitudinal seams and butt joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

Insulation installed outdoors shall be painted with two coats of UV-inhibiting coating recommended by the insulation manufacturer.

EXISTING INSULATION REPAIR

Repair damaged sections of existing mechanical insulation damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

END OF SECTION 230719

SECTION 232113 – ABOVE GROUND HYDRONIC PIPING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Fabricate and install hydronic piping in accordance with ASME B31.9, *Building Services Piping*.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for water piping materials and products.

PART 2 - PRODUCTS

MATERIALS AND PRODUCTS

Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.

PIPE AND PIPE FITTINGS

Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

STEEL PIPE AND PIPE FITTINGS

Carbon Steel Pipe: ASTM A53, Type E, Grade B for piping 2-1/2” NPS and larger or ASTM A53, Type F, Grade A for piping 2” NPS and smaller; plain or galvanized as indicated.

Cast-Iron Threaded Fittings: ANSI B16.4, plain or galvanized as indicated.

Malleable-Iron Threaded Fittings: ANSI B16.3, plain or galvanized as indicated.

Malleable-Iron Threaded Unions: ANSI B16.39, screwed, ANSI B1.20.1, Class 150 hexagonal stock with metal-to-metal bronze seats, plain or galvanized as indicated.

Threaded Pipe Plugs: ANSI B16.14, plain or galvanized as indicated.

Steel Flanges: Forged carbon steel, ASTM A105, slip-on type, 150 lb rating, plain, ANSI B16.9 raised face with 1/16" thick, non-asbestos ring type gasket, PTFE filled. Bolting shall be heavy hex head machine bolts or cap screws, ASTM A193-B7 steel alloy, with full nuts, ASTM A194- Gr. 2H steel alloy.

Carbon Steel Buttwelding Fittings: ASTM A234 Gr. WPB, seamless or welded, plain, ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns, rated to match connected pipe.

Carbon Steel Flanged Fittings: ASME B16.5, 150 lb rating, plain or galvanized as indicated, with 1/16" thick, non-asbestos ring type gasket, PTFE filled. Bolting shall be heavy hex head machine bolts or cap screws, ASTM A193-B7 steel alloy, with full nuts, ASTM A194, Gr. 2H steel alloy.

Forged Steel Socket Weld Fittings: ASME B16.11, Class 2000, plain.

Forged Steel Branch Fittings (Weld-o-lets™, Thread-o-lets™, etc.): Comply with MSS SP-97, with thickness to meet pipe pressure ratings; plain

COPPER TUBE AND FITTINGS

Copper Tube: ASTM B 88, Type (wall thickness) as specified for each service, hard-drawn temper, solder joint except as otherwise indicated.

Copper Solder-Joint Fittings: Cast copper allow per ANSI B16.18 or wrought copper per ANSI B16.22, with "Type" to match adjacent piping, solder joint

Brass Pipe Flanges: ANSI B16.1, cast brass, with heavy head machine bolts or cap screws, ASTM A193-B7 steel alloy, with hex full nuts, Type 304 stainless steel per ASTM A194-Gr. 2H. Gasket shall be 1/8" natural rubber, 35-45 Durometer hardness.

Copper-Tube Unions: Provide unions with cast copper alloy body with ball-and-socket, metal-to-metal seating surfaces complying with MSS SP-123, solder joint.

PLASTIC PIPE AND PIPE FITTINGS

Polyvinyl Chloride (PVC) Water Pressure Pipe and Fittings: PVC piping shall be UV-inhibited and fabricated in accordance with ASTM D 1785. Fittings shall be socket type to match adjacent piping. Utilize primer complying with ASTM F 656 and solvent cement complying with ASTM D 2564 joints.

MISCELLANEOUS PIPING MATERIALS

Welding Materials: Except as otherwise indicated, provide welding materials to comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

Soldering Materials: Except as otherwise indicated, provide soldering materials as follows:

Tin-Antimony Solder: ASTM B 32, Grade 95TA
Silver-Lead Solder: ASTM B 32, Grade 96TS. **Use on potable water systems is prohibited.**

Brazing Filler Metals: AWS A5.8, Classification BAgl (silver)

Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally effected by the chemical and thermal conditions of the fluid being carried.

PART 3 - EXECUTION

PIPING APPLICATIONS

Hydronic systems pressure pipe shall be steel as hereinbefore specified, applied as follows:

Pipe Size 2" NPS and Smaller: Carbon steel pipe, black, Schedule 40, Class 125 black cast-iron fittings, with threaded joints.

Exceptions:

At the Contractor's option, socket weld fittings may be used in lieu of threaded fittings.

At the Contractor's option, copper tube may be utilized lieu of steel piping.

INSTALLATION OF PIPING

Install eccentric reducers for horizontal piping where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush. Vertical piping use concentric reducers.

Reducers to be installed only where shown and at final connections to equipment. Install piping with 1/32" per foot (1/4%) to a point of drainage. Provide sufficient drains so that entire piping system can be emptied.

Connect branch-feed piping to mains at not more that 45-degrees above horizontal center line of mains, connect run-out piping to branches at not more that 45-degrees above horizontal center line of branches. **Connections above 45-degrees above horizontal center line or below the horizontal center line are prohibited.** Branch connections may be by forged steel branch fittings where branches are at least two pipe sizes smaller than the main.

Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

Fabricate pipe nipples from same pipe as used for connected pipe. Use Schedule 80 pipe for nipple fabrication where unthreaded length is less than 1-1/2" or where pipe size is less than 1-1/2" NPS. **Do not thread nipples full length, "close" nipples are prohibited.**

Strainers on condenser water lines shall be basket type, installed on pump suction lines. Strainers on all other water lines shall be Y-type. Run blow-off lines to nearest drain.

Construct piping joints as follows:

Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

For screwed joints, thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

Construct welded joints in accordance with Section 019913.

For flanged Joints, select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.

For soldered joints for copper tubing, apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's *Copper Tube Handbook*.

For brazed joints for copper tubing, comply with CDA's *Copper Tube Handbook*, "Brazed Joints" Chapter 9.

For plastic piping joints, clean and dry joining surfaces. Apply primer and then solvent cement to both surfaces. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. PVC joints shall comply with ASTM D 2855.

OWNER INSTRUCTION AND TRAINING

Provide Owner instruction and training in accordance with Section 019926.

END OF SECTION 232113

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

ANSI/ASME Compliance: Fabricate and install refrigerant piping in accordance with ANSI B31.5 *Refrigeration Piping and Heat Transfer Components.*

ASHRAE Compliance: Fabricate and install refrigerant piping in accordance with ASHRAE 15 *Safety Code for Refrigeration Systems.*

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for refrigerant piping materials and products.

PART 2 - PRODUCTS

COPPER PIPING

Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

Size 1" and Larger: Utilize copper tube in compliance with ASTM B88, Type K, hard-drawn temper, wrought-copper, brazed-joint fittings, brazed joints.

Size 3/4" and Smaller: Utilize copper tube in compliance with ASTM B 280, Type ACR, soft annealed temper fittings, cast copper-alloy fittings for flared copper tubes; flared joints.

Brazed Joints: Brazed joints using brazing alloy in compliance with ASTM B32. Use silver brazing alloy.

COPPER FITTINGS

Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

Copper Brazed-Joint Fittings: Cast copper per ANSI B16.18 or wrought copper per ANSI B16.22, with “type” to match adjacent piping.

Brass Pipe Flanges: ANSI B16.1, cast brass, with heavy head machine bolts or cap screws, ASTM A193-B7 steel alloy, with hex full nuts, Type 304 stainless steel per ASTM A194-Gr. 2H. Gasket shall be 1/8" natural rubber, 35-45 Durometer hardness.

Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.

REFRIGERANT VALVES

Service and Check Valves:

Service Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 deg. F temperature rating, 500 psi working pressure.

Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 deg. F temperature rating, 500 psi working pressure.

Solenoid Valves:

2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760 and UL 429, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, 24 volt, 60 Hz., Listed, 1/2" conduit adapter, 250 deg. F temperature rating, 400 psi working pressure. Provide manual operator to open valve.

Safety Relief Valves: Comply with ASME *Boiler and Pressure Vessel Code*, Listed and Labeled. Valve construction and ratings shall be as follows:

Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.

Piston, Closing Spring, and Seat Insert: Stainless steel.

Seat Disc: Polytetrafluoroethylene.

End Connections: Threaded.

Working Pressure Rating: 400 psig.

Maximum Operating Temperature: 240 deg F.

Thermostatic Expansion Valves: Comply with ARI 750. Incorporate reverse-flow option for heat-pump applications. Valve construction and ratings shall be as follows:

Body, Bonnet, and Seal Cap: Forged brass or steel.

Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.

Packing and Gaskets: Non-asbestos.

Capillary and Bulb: Copper tubing filled with refrigerant charge.

Suction Temperature: 40 deg F.

Superheat: Adjustable.

Working Pressure Rating: 450 psig.

Hot-Gas Bypass Valves: Comply with UL 429. Valve construction and ratings shall be as follows:

Body, Bonnet, and Seal Cap: Ductile iron or steel.

Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.

Packing and Gaskets: Non-asbestos.

Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.

Seat: Polytetrafluoroethylene.

Equalizer: Internal.

Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter.

Throttling Range: Maximum 5 psig.

Working Pressure Rating: 500 psig.

Maximum Operating Temperature: 240 deg F.

REFRIGERANT SPECIALTIES

Refrigerant Strainers: Brass shell and end connections, brazed joints, monel screen, 100 mesh, Listed, 500 psig working pressure.

Moisture-Liquid Indicators: Forged brass, single port, removable cap, fused glass, 240 deg. F temperature rating, 500 psi working pressure.

Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.

Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated.

Refrigerant Discharge Line Oil Separator: Separator shall be high efficiency centrifugal type designed for use with the type of refrigerant in the system, rated for at least 450 psig working pressure.

Replaceable-Core Filter Dryers: Provide filter dryers in compliance with ARI 730. Body and cover shall be painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets. Filter media shall be 10 micron, pleated with integral end rings; stainless-steel support. Working pressure rating of 500 psig and maximum operating temperature of 240 deg F.

Flexible Connectors: Connectors shall have stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket. Connector shall be capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly. Factory test at minimum of 500 psig and maximum operating temperature of 250 deg F.

PART 3 - EXECUTION

PIPING INSTALLATION

Select system components with pressure rating equal to or greater than system operating pressure.

Install refrigerant piping according to ASHRAE 15, as follows:

Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

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.

Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

Install piping adjacent to machines to allow service and maintenance.

Install piping free of sags and bends.

Install fittings for changes in direction and branch connections.

Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.

Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Slope refrigerant piping as follows:

Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.

Install horizontal suction lines with a uniform slope downward to compressor.

Use double-suction riser for maximum compressor efficiencies if load variation is expected.

Install traps and double risers to entrain oil in vertical runs.

Liquid lines may be installed level.

When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Protect refrigerant piping as follows:

Install underground refrigerant piping in protective PVC piping or conduit.

Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

PIPE JOINT CONSTRUCTION

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

Construct solder joints according to ASTM B 828 or CDA's *Copper Tube Handbook*.

Construct brazed joints according to AWS's *Brazing Handbook*, Chapter "Pipe and Tube."

Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.

Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

For flanged joints, select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

VALVE AND SPECIALTY APPLICATIONS

Refrigerant valves and specialties shall be installed for each refrigerant system either as an original equipment manufacturer (OEM) installation or field-installed, as follows:

Install line-sized shutoff valves and flexible connectors in suction and discharge lines of each compressor.

Install line-sized shutoff valves on each side of other refrigeration equipment, including condensers, evaporators, receivers, etc. in multiple unit installations.

Install service valves for gage taps at strainers if they are not an integral part of strainers.

Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

Install filter dryers in liquid line between compressor and thermostatic expansion valve and in the suction line at each compressor, complete with full-sized three-valve bypass around filter dryers utilizing line-sized shutoff valves, so that filter dryer may be replaced while system remains in operation. Filter dryers shall be installed in the horizontal position, except that replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with operator at top.

Install thermostatic expansion valves as close as possible to distributors on evaporators. Install valve so diaphragm case is warmer than bulb. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Locate bulb on top of the suction line smaller than 2-1/8" OD and at the 4 o'clock or 8 o'clock position on larger lines. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

Where required by the compressor manufacturer, install discharge line oil separator on the discharge of each compressor, downstream of the flexible connector and/or discharge muffler, securely anchored to the unit. Oil return shall be connected to the compressor in accordance with manufacturer recommendations.

Install safety relief valves where required by ASME *Boiler and Pressure Vessel Code*. Pipe safety relief valve discharge line to outside according to ASHRAE Standard 15.

Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

Install strainers upstream from and adjacent to the following unless they are furnished as an integral OEM assembly for device being protected:

- Solenoid valves
- Expansion devices
- Compressors

FIELD QUALITY CONTROL

Clean and test refrigerant piping in accordance with ANSI B31.5, Chapter VI. Perform initial test with dry nitrogen, using soap solution to test all joints. Perform final test with 27" vacuum, and then 200 psi using electronic leak detector. System must be entirely leak-free. **Submit leak test reports to A/E for review.**

Repair or replace refrigerant piping as required to eliminate leaks, and retest as specified to demonstrate compliance.

DEHYDRATION AND CHARGING SYSTEM

Install core in filter dryer after leak test but before evacuation.

Evacuate refrigerant system with vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.

Break vacuum with refrigerant gas, allow pressure to build up to 2 psig.

Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

END OF SECTION 232300

SECTION 233100 – HVAC DUCTWORK

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

NFPA Compliance:

Comply with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*.

Comply with NFPA 90B, *Standard for the Installation of Warm Air Heating and Air Conditioning Systems*.

SMACNA Compliance: Fabricate and install all ductwork and ductwork accessories in accordance with *HVAC Duct Construction Standards - Metal and Flexible*.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for ductwork and products.

PART 2 - PRODUCTS

DUCTWORK MATERIALS

Galvanized Sheet Metal: Except as indicated otherwise, fabricate ductwork from galvanized sheet steel complying with ASTM A 653, lockforming quality, with G 90 zinc coating in accordance with ASTM A 653 and mill phosphatized for exposed locations. Stamp gauge and manufacturer's identification on each sheet. Break sheets so that identification is exposed.

Flexible Ducts: Metallic or non-metallic, insulated flexible ductwork complying with UL 181B. Provide 1" thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

DUCT FABRICATION

Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

Shop fabricate supply, return, and ventilation air ductwork of gauges and reinforcement complying with SMACNA's *HVAC Duct Construction Standards - Metal and Flexible*, **with the exception that sheet metal less than 24-ga. shall not be used for rectangular duct**, in accordance with the following:

Application	Construction Pressure Class
Return and Ventilation Ductwork	-2" W.G.
Supply Ductwork With Fan Static Pressure Less Than 2.5" W.G.	+2" W.G

Shop fabricate exhaust and relief ductwork of the following gauge sheet metal with reinforcement complying with SMACNA's *HVAC Duct Construction Standards - Metal and Flexible:*

Maximum Diameter or Maximum Rectangular Dimension (inches)	Sheet Metal Gauge
8	24
18	22
30	20
>30	18

Elbows/Tees:

Radius elbows and tees shall be fabricated as **full radius** elbows with the centerline radius 1.5 times the duct width.

Square throat elbows shall be constructed with double-wall airfoil turning vanes properly spaced for the duct width. Turning vanes and vane runners shall be constructed in accordance with SMACNA's *HVAC Duct Construction Standards - Metal and Flexible*, Figure 4-3. **Square throat elbows may be used only when the available space is insufficient for use of a full radius elbow**.

Perforated Metal Plenum Air Baffles: Construct of 50% free area perforated 304 stainless steel with angle iron supports and bracing to prevent bulging, rattling, etc. Metal thickness shall be as follows:

Fan Total Static Pressure	Gauge
Up to 4"	22

ROUND DUCTWORK

Construction: Construct round ductwork in accordance with Section 3 of SMACNA's *HVAC Duct Construction Standards - Metal and Flexible*, complying with the Pressure Class designations hereinbefore specified. Use spiral lockseam construction for ductwork up to 58" diameter and welded longitudinal seam for larger ductwork, 26 gauge minimum.

Exception: Round ducts that connect to air outlets or inlets may be constructed with a snaplock longitudinal seams complying with Fig. 3.2 of SMACNA's *HVAC Duct Construction Standards - Metal and Flexible,* 26 gauge minimum.

PART 3 - EXECUTION

INSTALLATION OF DUCTWORK

Assemble and install ductwork to achieve air-tight operation with no objectionable noise, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth.

Support ducts in accordance with Section 230529 to hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor or roof penetration in accordance with Section 230529.

At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure fabricated of 6 mil PVC film or other covering that will prevent entrance of dust and debris until time connections are to be completed.

Routing:

Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs unless such routing is clearly indicated on the Drawings. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct useable space or block access for servicing building and its equipment. Coordinate layout with suspended ceiling, lighting, fire suppression systems, and similar finished work.

Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Unless indicated otherwise, install duct as high as possible.

Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation.

Wherever possible in finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction, or above ceilings.

Elbows: **Utilize radius elbows for all changes of direction unless specifically indicated otherwise on the drawings or space limitations dictate the use of square throat elbows with turning vanes**. Where square throat elbows with turning vanes are installed, provide a duct access door or panel immediately upstream of each elbow.

Sealing: Ductwork shall be sealed in accordance with SMACNA's *HVAC Duct Construction Standards - Metal and Flexible*, as follows:

Duct Construction Class	Seal Class
+/- 1" W.G. or less	C
+/- 2" W.G.	B

Testing:

Ductwork indicated to be constructed in accordance with Pressure Class +/-3" W.G. or greater shall be tested, section by section, in accordance with SMACNA's HVAC *Air Duct Leakage Test Manual*. Air leakage factor (CL), computed in accordance with the following relationship, shall be less than or equal to 6.0:

$$CL = \text{Leakage rate (cfm/100 sf of duct surface)} \times (\text{Test static pressure})^{0.65}$$

Ductwork utilized as part of a smoke control system shall be tested, section by section, in accordance with SMACNA's HVAC *Air Duct Leakage Test Manual* and leakage shall not exceed 5% of design airflow.

INSTALLATION OF FLEXIBLE DUCTS

Flexible duct shall only be allowed where indicated on the drawings, installed as follows:

Install duct fully extended; do not install in the compressed state or use excess lengths.

Avoid bending ducts across sharp corners or incidental contact with metal fixtures, pipes or conduits. Radius at center line of bends shall not be less than one duct diameter.

All connections, joints and splices should be made in accordance with the manufacturer's installation instructions.

All tapes, mastics and non-metallic fasteners (plastic clamps) used for field installation of flexible ducts should be listed and labeled to UL 181B.

Sheet metal collars to which flexible ducts are attached should be a minimum of 2 inches in length and shall be beaded.

Sheet metal sleeves used for joining two sections of flexible duct should be a minimum of 4 inches in length and beaded on both ends.

Metal Duct Connection: Spin-in conical connectors with integral balancing damper shall be used for connecting flexible runouts to metal ductwork.

Ceiling Diffuser Connections: Connect flexible duct to supply air diffusers in accordance with SMACNA's *HVAC Duct Construction Standards - Metal and Flexible*, Figure 7-7, and as indicated on the Drawings.

ADJUSTING AND CLEANING

Clean ductwork internally, section by section, as it is installed, of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration. After cleaning, seal open ends and connections with 6 mil PVC film.

Clean existing ductwork to which new ductwork is connected in accordance with Section 230557.

END OF SECTION 233100

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

UL Compliance:

Construct, test, and label fire dampers in accordance with UL Standard 555, *Standard for Fire Dampers*.

Construct, test, and label smoke and combination fire/smoke dampers in accordance with UL Standard 555S, *Standard for Smoke Dampers*.

Construct, test, and label ceiling radiation dampers in accordance with UL Standard 555C, *Standard for Ceiling Dampers*.

NFPA Compliance: Comply with applicable provisions of NFPA 90A and/or NFPA 90B pertaining to installation of ductwork accessories.

AMCA Compliance:

Test and rate airflow dampers in accordance with ANSI/AMCA Standard 500-D, *Laboratory Methods of Testing Dampers for Rating*.

Test and rate louvers in accordance with AMCA Standard 500-L, *Laboratory Methods of Testing Louvers for Rating*.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction, and installation instructions. Provide specific instructions for installation of fire and smoke dampers to comply with listed installation arrangement.

PART 2 - PRODUCTS

AIRFLOW DAMPERS

Low Pressure Manual (Balancing) Dampers:

Construction: Dampers installed in dishwasher exhaust ductwork, return air ductwork in natatoriums, and in other wet locations shall be constructed of Type 316 stainless steel, including shafts and hardware exposed to the airstream. All other dampers shall be constructed of G90 galvanized steel with zinc-plated shafts and hardware exposed to the airstream. Single blade or multiblade volume damper shall be constructed in accordance with SMACNA's *HVAC Duct Construction Standards - Metal and Flexible*, Figures 7-4 and 7-5.

Quadrant Locks: Provide each low pressure balancing damper with a quadrant lock device on one end of shaft, and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

FLEXIBLE DUCT CONNECTORS

Provide flexible connector between ductwork and any fan or air-handling unit connected to the ductwork. Connectors shall be fabricated of noncombustible fabrics and any coatings or adhesives applied shall comply with UL 181, Class 1. Frame shall be steel and fabric shall be 26 oz/sq. yd or heavier. Connector shall be sized for minimum 50% additional travel and/or deflection at full airflow.

Where flexible connectors are located downstream of electric heating coils or installed in ductwork that serves as part of a smoke control system, the connector shall be rated for application at temperatures up to 250°F.

PART 3 – EXECUTION

INSTALLATION

Adjust ductwork accessories for proper settings.

END OF SECTION 233300

SECTION 238116 – DUCTLESS SPLIT SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

AHRI Compliance:

Testing and rating of packaged air-cooled heating and cooling units shall be in accordance with AHRI Standard 340/360 or AHRI Standard 210/240, as applicable.

Rate outdoor air-cooled unit sound power levels according to AHRI 270, *Sound Rating of Outdoor Unitary Equipment.*

ASHRAE Compliance: Refrigeration system shall be in accordance with ASHRAE 15, *Safety Code for Mechanical Refrigeration*.

North Carolina Building Code Compliance: Air-conditioning units shall meet or exceed the minimum efficiency rating required by the *North Carolina State Building Code: Energy Conservation Code* when tested, rated, and certified in accordance with AHRI 210/240 or 340/360, as applicable.

Extended Warranty: **The Contractor shall provide an extended parts and labor warranty on each refrigeration compressor in addition to guarantees and warranties required under the General Conditions to the Construction Contract.**

The *parts* portion of the warranty shall be directly from the manufacturer to the Owner.

The *labor* portion of the warranty shall also be provided directly from the manufacturer to the Owner.

Exception: Where a manufacturer labor warranty is not available, the Contractor shall provide a labor warranty directly to the Owner.

This warranty shall provide for repair or replacement of the covered compressor**, including removal and/or replacement of refrigerant,** that becomes inoperative as a result of defects in materials or workmanship within 4 years after the date ending the initial 1-year guarantee period for the Project.

Acoustic Criteria: HVAC equipment shall be selected and installed to comply with the acoustic criteria defined in Section 230510.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories, and installation and start-up instructions.

PART 2 - PRODUCTS

SINGLE ZONE DUCTLESS SPLIT-SYSTEM

Description: System shall consist of a slim-silhouette wall-mounted indoor fan coil and outdoor unit with inverter-driven scroll compressor designed for cooling-only or heat pump duty, as indicated on the Drawings.

Indoor Unit: Provide indoor unit with wall-mounting bracket, consisting of the following:

Indoor 3-speed fan driven by a motor complying with the requirements of Section 230513.

Impact-resistance plastic casing with manual adjustable guide vane to adjust air discharge direction from side to side and integral, motorized air sweep louver to maintain uniform air distribution.

Removable, washable air filter, with minimum MERV of 6.

Refrigerant coil complying with the requirements of Section 238216.

Drain pan with drain connection. On down flow units and all other coils that do not have a secondary drain pan or provisions to install a secondary or auxiliary pan, a water level monitoring device shall be installed inside the primary drain pan. The device shall shutoff the equipment served in the event that the primary drain pan becomes restricted. Devices installed in the drain line shall not be permitted.

Outdoor Unit: Provide outdoor unit consisting of the following:

Galvanized steel casing with an electrostatically applied, thermally fused acrylic or polyester powder coating.

Hermetic, inverter driven, variable speed scroll compressor.

Outdoor propeller fan driven by a DC motor with permanently lubricated bearings.

Refrigerant coil complying with the requirements of Section 238216 and with epoxy phenolic coating.

Low Ambient Control: Provide factory-installed low ambient damper assembly, fan speed control, or fan cycling control for cooling operation down to 0°F ambient. Include all other accessories necessary for low-ambient application.

Refrigerant Piping: Refrigerant piping shall be sized and furnished by the unit manufacturer and shall be insulated in accordance with Section 230719.

Electrical Connection: System shall be configured for a single electrical power service connection to the outdoor unit, with electrical service to be provided from the outdoor unit to the indoor unit utilizing factory-provided electrical connections. Make electrical connections in accordance with Section 230511.

Controls: A microprocessor-based controller shall be incorporated for system control, responding to inputs (setpoint, operating mode, schedule, etc.) from a wall-mounted, wireless device located where indicated on the Drawings. The controller shall sense the return air temperature, the indoor coil temperature and control both indoor and outdoor unit operation to maintain space temperature setpoint. For heat pump units, changeover from heating to cooling and the reverse shall be automatic.

PART 3 - EXECUTION

INSTALLATION

Install units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes. Arrange installation to provide access space around units for service and maintenance.

Coordinate piping installations and specialty arrangements with schematics on the Drawings and with requirements specified above for refrigerant piping systems. Install piping adjacent to unit to allow for required access for service and maintenance.

Provide condensate drain piping and terminate drains outdoors or at floor drains as indicated on the Drawings.

Make electrical service connection in accordance with Section 230511.

Do not operate unit fans until filters are in place.

Touch-up factory exterior paint as required to repair scratches or other damage.

OWNER INSTRUCTION AND TRAINING

Provide Owner instruction and training.

END OF SECTION 238116

SECTION 238120 – SPLIT SYSTEM HEAT PUMP UNITS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

AHRI Compliance:

Testing and rating of split system heat pumps shall be in accordance with AHRI Standard 210

Rate outdoor air-cooled unit sound power levels according to AHRI 270, *Sound Rating of Outdoor Unitary Equipment*

ASHRAE Compliance: Refrigeration system construction of packaged units shall be in accordance with ASHRAE 15, *Safety Code for Mechanical Refrigeration*.

North Carolina Building Code Compliance: Packaged units shall meet or exceed the minimum efficiency rating required by the *North Carolina State Building Code: Energy Conservation Code* when tested, rated, and certified in accordance with AHRI 210/240.

Unit will be certified for capacity and efficiency,and listed in the latest AHRI directory.

Unit construction will comply with latest edition of ANSI/ ASHRAE and with NEC.

Unit will be constructed in accordance with UL standards and will carry the UL label of approval. Unit will have c--UL approval.

Extended Warranty: **The Contractor shall provide an extended parts and labor warranty on each refrigeration compressor in addition to guarantees and warranties required under the General Conditions to the Construction Contract.**

The *parts* portion of the warranty shall be directly from the manufacturer to the Owner.

The *labor* portion of the warranty shall also be provided directly from the manufacturer to the Owner.

Exception: Where a manufacturer labor warranty is not available, the Contractor shall provide a labor warranty directly to the Owner.

This warranty shall provide for repair or replacement of the covered compressor**, including removal and/or replacement of refrigerant,** that becomes inoperative as a result of defects in materials or workmanship within 4 years after the date ending the initial 1-year guarantee period for the Project.

Acoustic Criteria: HVAC equipment shall be selected and installed to comply with the acoustic criteria defined in Section 230510.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties, piping and accessories, and installation and start-up instructions.

Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation of indoor air handlers and outdoor heat pump units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

PART 2 - PRODUCTS

INDOOR AIR HANDLER

General: Provide cabinet type Air Handler of capacities, style, and having accessories as scheduled on the Drawings. Include chassis, coils, removable fan and motor board, drain pan assembly, filter, insulation, and accessories as indicated on the Drawings.

Chassis: Construct chassis of galvanized steel with flanged edges. Unit shall meet 125 hour salt spray test per ASTMB-117. For floor-mounted units, provide leveling screws.

Unit Liner: Enclosures shall be internally insulated with minimum 1/2” thickness of rigid mineral fiber board in accordance with ASTM C 612, Type II, with kraft paper and foil jacket, in accordance with ASTM C 921,Type 1, on the airstream side. All leading and trailing edges shall be protected from airstream contact by metal flanges, channels, etc. Insulation must meet all requirements of ASTM C1071 (including C665), UL 181 for erosion, and carry a 25/50 rating for flame spread/smoke developed per ASTM E-84, UL 723 and NFPA 90A.

Cabinet: Provide cabinet constructed of 14-ga steel for floor mounted units and 18-ga for suspended ceiling units. Cabinet shall consist of removable panels with baked enamel finish in manufacturer's standard color selected by the A/E. Cabinet configuration shall be as indicated on the Drawings.

All units shall have a minimum 1" duct collar on the discharge and have plastic grommets at each piping penetration through exterior cabinet. All access panels shall be fully insulated and attached with standard fasteners on all four sides. Access panels shall be quick open access panels. No coil, drain piping, or electrical connections shall pass through any access panel.

All DX coils shall be tested to 450 PSIG pressure and factory sealed and charged with a minimum of 5 psig nitrogen. DX coils shall be provided with orifice metering device.

Electric Aux Heater shall be UL listed, disc-type automatic and manual reset-type thermal safety devices, two stage control. Factory mounted within air handler with single-point power connection. Provide mercury contactors, heater fuses, and heater door interlocking disconnect switch.

Drain Pan: Construct of one piece Type 304 stainless steel with welded corner construction. Insulate with 1/2" thick non-hydroscopic insulation. Provide 3/4" drain connection. Drain pan shall extend under control valve assembly.

Fan and Motor Board: Provide removable fan and motor board as follows:

Fan: Unit fan shall be dynamically balanced, forward curved, direct drive DWDI wheel with 18 gauge galvanized chromate coated double inlet scroll.

Motor: Provide variable speed motor. Blower motor shall be high efficiency, ECM type with thermal overload protection and three separate horsepower taps.

Wiring Termination: Connect motor to chassis wiring with plug connection.

Filters: Provide 2” pleated filters of MERV 8 or greater..

Provide bracing in center of filter rack where multiple filters are required.

Electrical Connection: Units shall be furnished with a single point power connection and electrical junction box for motor and other electrical terminations. Disconnects shall be mounted external for exposed units in mechanical closets. All disconnects and mounting locations must meet all code requirements.

OUTDOOR HEAT PUMP

General: Outdoor-mounted, air-cooled, split system heat pump unit suitable for ground or rooftop installation. Unit consists of a hermetic compressor, an air-cooled coil, forward-swept blade propeller-type condenser fan, and a control box. Unit will discharge supply air as shown on contract drawings. Unit will be used in a refrigeration circuit to match up to a packaged air handler.

Unit Cabinet: Unit cabinet, including louvered coil guard, will be constructed of galvanized steel, bonderized, and coated with a powder coat paint.

Fans: Condenser fan will be direct--drive propeller type, discharging air upward. Condenser fan motors will be totally enclosed, 1--phase type with class B insulation and permanently lubricated bearings. Shafts will be corrosion resistant. Fan blades will be statically and dynamically balanced. Condenser fan openings will be equipped with coated steel wire safety guards.

Compressor: Compressor will be hermetically sealed. Compressor will be mounted on rubber vibration isolators. Compressor shall be minimum 2-stage.

Condenser Coil: Condenser coil will be air cooled. Coil will be constructed of aluminum fins mechanically bonded to copper tubes which are then cleaned, dehydrated, and sealed. Provide coils with epoxy phenolic coating and hail guards.

For each compressor, include thermally protected compressor motor and Crankcase heater.

Refrigeration Components: Refrigeration circuit components will include liquid--line shutoff valve with sweat connections, vapor--line shutoff valve with sweat connections, system charge of Puron (R--410A) refrigerant, and compressor oil. Unit will be equipped with high--pressure switch, low pressure switch and filter drier for Puron refrigerant.

Low Ambient Control: Provide factory-installed low ambient damper assembly, fan speed control, or fan cycling control for cooling operation down to 0°F ambient. Include all other accessories necessary for low-ambient application.

Heat Pump Control:

Reversing Valves: 4-way low voltage solenoid valve piping to direct hot gas flow to the indoor coil when energized (heating mode) and to the outdoor coil when de-energized (cooling mode).

Heating Cycle Controls:

Heating: Provide multistage heating control. For each refrigerant circuit, the first stage shall energize the reversing valve, directing hot gas to the indoor coil. On a continued fall in space temperature, energize the supplemental heat.

Defrost Cycle: When in the heating cycle, a buildup of ice on the outdoor coil shall result in the controls de-energizing the reversing valve, directing hot gas from the compressor to the outdoor coil to defrost it. The outdoor fan(s) shall stop. Once the ice melts, energize the reversing valve shall be energized to the heating position to direct hot refrigerant gas to the indoor coil. The outdoor fan shall operate.

Refrigerant Piping Size**: Regardless of refrigerant piping sizes indicated on plans, condensing unit manufacturer shall verify sizing to complement length and elevation of piping. Additionally, include all condensing unit accessories necessary to complement length and elevation of piping.**

LOW-VOLTAGE, ELECTRONIC PROGRAMMABLE THERMOSTATS

Low voltage thermostat, 7-day programmable type with 55 to 85 deg F setpoint range and 2 deg F maximum differential capable of controlling packaged heating/cooling systems, including heat pumps.

Thermostat shall include LCD display for current conditions, setpoints, and programming menus.

Thermostat shall have the capability of using remote temperature sensors in averaging algorithm.

Users shall be capable of adjusting thermostat +/-2°F (adj) of comfort range (70°F-75°F).

Thermostat shall incorporate the following features:

Automatic switching from heating to cooling.

Preferential rate control to minimize overshoot and deviation from setpoint.

Instant override of set point for continuous or timed period from 1 hour to 31 days.

Short-cycle protection.

Selection features include degree F display, 12-hour clock, keyboard disable, remote sensor, and fan on-auto.

Battery replacement without program loss.

Thermostat display features shall include the following:

Time of day.

Actual space temperature.

Programmed temperature setpoint.

Programmed time.

Duration of timed override.

Day of week.

System mode indications, including “cooling”, "heating," "off," "fan auto," and "fan on."

Unit controls, including final control elements, to meet the required sequences shown on the Drawings.

PART 3 - EXECUTION

INSTALLATION

Install units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes. Arrange installation to provide access space around units for service and maintenance.

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. Install piping adjacent to unit to allow for required access for service and maintenance.

Do not operate unit fans until filters are in place. Install new filters in units prior to final acceptance. Touch-up factory exterior paint as required to repair scratches or other damage.

FIELD QUALITY CONTROL

Upon completion of installation of heat pump units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

OWNER INSTRUCTION AND TRAINING

Provide Owner instruction and training.

END OF SECTION 238120

SECTION 238216 – AIR COILS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to construction and installation of electric coils.

UL Compliance:

Comply with applicable requirements of UL 1025, *Electric Air Heaters*.

Comply with UL 486A, *Wire Connectors and Soldering Lugs for Use with Copper Conductors*.

Assemble electric coils in accordance with UL 1995.

NEMA Compliance: Provide electric duct heater accessories that comply with NEMA standards.

NFPA Compliance: Comply with applicable requirements of NFPA 90A and NFPA 90B pertaining to construction and installation of electric coils.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific. See Section 019913 for exact requirements.

Manufacturer's Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.

PART 2 - PRODUCTS

REFRIGERANT COILS

Fins: Construct of continuous aluminum or copper configured plate-fin type, as indicated on the Drawings. Provide minimum thickness of .0075”.

Tubes: Construct of 5/8" seamless copper tubes in accordance with ASTM B 753. Provide minimum thickness of .025”.

Suction and Distributor Piping: ASTM B 88, Type L copper tube with brazed joints.

Casings: Construct of 16-ga continuous coated galvanized steel for coil heights 33" and smaller; 14-ga for coil heights over 33". Provide formed end supports and top and bottom channels. Provide 16-ga steel center tube support for coil lengths 42" to 96", 2 or more supports for coil lengths over 96".

Testing: Factory test refrigerant coils at 450 psi and leak test at 300 psi under water; clean, dehydrate, and seal with dry nitrogen charge.

Coating: As indicated on the Drawings, coils shall be coated with epoxy phenolic coating.

Headers: Provide refrigerant distributor of venturi type with low pressure drop design, arranged for down feed and maximum of 12 circuits per distributor. Provide seamless copper tube suction header.

ELECTRIC COILS

General: Provide slip-in electric coils with disc type automatic reset thermal cutouts for primary over-temperature protection and with disc type load-carrying manual reset thermal cutouts, factory-wired in series with each heater stage, for secondary protection. Heat limiters or other fusible overtemperature devices are not acceptable. Provide electric coils with the following additional construction features:

Open-Coil Electric Element: Construct coils with resistance wire type A of 80 percent nickel/20 percent chromium, insulated by floated ceramic bushings. Recess bushings into casing openings and secure on supporting brackets, spaced 4" o.c. maximum. The heating wire for each stage shall be strung across the entire face of the coil to prevent stratification when operating at less than full capacity.

Heaters shall be rated for the voltage, phase, and number of heating stages as indicated in the schedule. All three phase heaters shall have equal, balanced, three phase stages. All internal wiring shall be stranded copper with 105 degrees C insulation and shall be terminated in crimped connectors or box lugs.

Terminal blocks shall be provided for all field wiring and shall be sized for installation of 75 degrees C copper wire in accordance with NEC requirements.

Trim: All terminals and nuts shall be constructed of stainless steel, and terminal insulators, brackets and bushings shall be constructed of ceramic and securely positioned.

Casings: Heater frames and terminal boxes shall be constructed of aluminized or galvanized steel. Terminal box shall be NEMA 1 construction and shall be provided with a hinged, latching cover and multiple concentric knockouts for field wiring.

Heater controls shall be factory wired in insulated enclosure and shall be provided complete with the items indicated below:

Automatic reset thermal cutouts prewired into control circuit

Differential pressure switch

Limit control duty magnetic contactors

Control circuit transformer for 24V control
Non-fused safety disconnect switch interlocked with heater terminal box cover

PART 3 - EXECUTION

INSTALLATION OF REFRIGERANT COILS

Install coils as indicated, and in accordance with manufacturer's installation instructions.

Mount coils on steel supports to form banks or stacks as indicated, brace, secure to air intake chamber. Place in location to permit installation of bypass damper if required, provide steel baffles where required to prevent bypassing of air.

Pitch coil casings for drainage, not less than 1/8" toward return connections, except where drainage feature is included in coil design.

INSTALLATION OF ELECTRIC COILS

Install electric coils including components as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices; complying with applicable installation requirements of NFPA 70 and NECA's "Standard of Installation."

Coordinate with other electrical work, including wiring/cabling, as necessary to properly interface installation of electric coils with other work.

Clean dust and debris from each electric duct heater as it is installed to ensure cleanliness.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A.

Provide equipment grounding connections for electric coils as required by NFPA 70. Tighten connections to comply with tightening torque values specified in UL Std. 486A to assure permanent and effective grounding.

END OF SECTION 238216

SECTION 260000 - SUMMARY OF ELECTRICAL WORK

Engineer of Record for electrical work is Addison Dee, PE, Salas O'Brien., 1620 Midtown Place (27609), P. O. Box 19944, Raleigh, NC 27619. Electrical work shall be defined by drawings numbered with the prefix "E", the general provisions of the Contract including General Conditions and Supplementary Conditions, Division 1 Specifications sections, and Division 26-28 Technical Specifications listed below. In addition, electrical work may be defined by reference to other documents from any of the above-named sources as well as by project addenda.

DIVISION 26 - ELECTRICAL

Section	Title
260000	Summary of Electrical Work
260500	Basic Electrical Requirements
260519	Secondary Voltage Wires and Cables
260526	Grounding
260529	Supporting Devices
260533	Electrical Identification
260534	Raceways
260535	Electrical Boxes and Fittings
260579	Temporary Power and Lighting
260590	Painting
260593	Electrical Connections for Equipment
260800	Testing and Placing in Service
262416	Panelboards
262726	Wiring Devices
262813	Fuses
262816	Enclosed Switches and Circuit Breakers
263213	Diesel Generator Set
263623	Automatic and Non-Automatic Transfer Switches
264313	Surge Protective Devices (SPD)

END OF SECTION 260000

SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

SCOPE

The electrical design for this project is based on the requirements of the *National Electrical Code* (NEC), NFPA-70, 2017 Edition. Where not restricted to more stringent requirements by the Drawings and Specifications, the minimum requirements of the NEC shall prevail.

Contractor shall coordinate the work and equipment of this Division with the work and equipment specified elsewhere to assure a complete and satisfactory installation.

It is the intention of these Specifications and Drawings to call for finished work, tested and ready for operation. Whenever the words "supply," "provide," or "furnish" are used, it shall mean "furnish and install complete and ready for use at no additional cost."

Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the Work the same as if herein specified or shown.

Some items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items of equipment as indicated on the Drawings, and as required for complete systems. The words “and” and “or” shall be interpreted in both the singular and plural sense (and/or) as appropriate to the use.

Electrical service entrance equipment arrangements for temporary and permanent connections to the Owner's system shall conform to the Owner's requirements. Coordinate circuit breakers with the existing system.

All ampacities or other conductor references where indicated or otherwise specified in the Drawings or Specifications are based on copper conductors. **Aluminum conductors are not acceptable and will not be permitted.**

DEFINITIONS

Definitions for "Concealed" and "Exposed" are provided for the purpose of specifying wiring methods or for defining the appearance of finished work and are not the same as definitions used in the National Electrical Code.

Concealed: Work within or behind various construction elements or in crawl spaces or trenches that is not exposed to view when the project is complete.

Exposed: Not "concealed" as defined above, or anything exposed to view when the project is complete.

Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization accredited by NCBCC (North Carolina Building Code Council) to label electrical equipment and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Listed: Equipment or materials included in a list published by an organization accredited by NCBCC (North Carolina Building Code Council) to label electrical equipment and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate designated standards or has been tested and found suitable for use in a specified manner.

Wiring: Cable, raceways, fittings, mechanical supports, wire, junction boxes, device boxes, outlet boxes, switches, cutouts, and related items.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

ENERGIZED SYSTEM WARNING

Extreme caution is enjoined with regard to work with and around energized electrical equipment. The Contractor is urged to coordinate all such activities with the Owner or the local electric utility so that electrical equipment may be de-energized as required to safely perform necessary construction activities as defined in the Drawings and Specifications. Suitable OSHA approved lockout-tagout procedures shall be used when circuits or equipment have been de-energized for the purpose of performing construction activities. All work practices related to worker safety are the complete responsibility of the Contractor.

DUTIES OF CONTRACTOR

The Drawings are generally diagrammatic in nature and are neither intended to show each fitting, box, elbow, offset, hanger, *etc.*, nor a complete detail of all work to be done. The Drawings are for the purpose of illustrating the type of system, showing raceway sizes, *etc.*, and special conditions considered necessary for the experienced mechanic to take off materials and lay out work. This Contractor shall be responsible for taking such measurement as may be necessary at the job and adapting his work to local conditions.

Contractor shall furnish and install all materials called for or reasonably implied in these Specifications and accompanying Drawings. Apparatus must be furnished complete and ready for operation in every respect. Materials and equipment called for in the Specifications and not indicated on the Drawings, or indicated on the Drawings and not called for in the Specifications, shall be furnished by the Contractor.

Contractor is responsible for familiarizing himself with the project area and details of the construction of building. Work performed under these Specifications that is installed improperly or which requires modification due to improper reading or interpretation of building plans shall be corrected or otherwise modified as directed by the A-E without additional cost to the Owner.

Contractor shall follow Drawings in laying out work and shall refer to drawings of other trades to verify exact spaces in which work will be installed. Arrange installed items in such a manner as to maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, A-E shall be notified before proceeding with installation.

INSPECTIONS

The contractor shall notify the office of the local Authority Having Jurisdiction, to schedule required inspections. This shall include all inspections of concealed work, interior and exterior, as well as intermediate and final reviews.

COOPERATION WITH OTHER TRADES

The Contractor shall give full cooperation to other trades and shall furnish any and all information necessary to permit the work of other trades. Information to be provided by the Contractor includes, but is not limited to templates, patterns, setting plans, and shop details as may be necessary for the proper installation of work and for the purpose of coordinating adjacent work. Information required by other trades shall be provided in a timely manner and shall be sufficient to allow the work of such other trades to proceed with the least possible interference or delay.

Where the work of the Contractor will be installed in close proximity to, or may interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. **If the Contractor installs his work before coordination with other trades, he shall make the necessary changes in his work to correct the condition without extra charge.**

Scaled Shop Drawings: If so directed by the A-E, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 3/8"=1'-0", clearly showing how his work is to be installed in relation to the work of other trades.

SAFETY REQUIREMENTS

All systems shall be installed so as to operate in a safe manner; all moving parts shall be covered where there is any possibility of danger from such moving parts. All rough edges of equipment and materials shall be made smooth.

All safety controls shall be checked under the supervision of the Owner's representative and two (2) copies of test data showing setting and performance of safety controls shall be submitted to the A-E by the Contractor.

During the construction the Contractor shall keep the site reasonably clean of debris and upon completion of construction he shall clean up the premises to remove all evidence of his work. The Contractor shall provide, at no additional cost to the Owner, additional cleaning of the site as directed by the Owner. In addition, upon completion of construction, he shall clean, wash and/or polish all fixtures, equipment and exposed material and leave each item clean, bright, and without blemish. Damaged items shall be replaced or repaired in a manner satisfactory to the Owner by the Contractor at no additional cost to the Owner.

It shall be the responsibility of the Contractor to maintain a safe working environment at all times and to comply with all OSHA regulations for the duration of the project.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Manufacturer's Data: Submit manufacturer's technical product data.

NAMEPLATE DATA

Each item of electrical utilization equipment shall be provided with a permanent operational data nameplate that shall, as a minimum, indicate the following: equipment manufacturer, product name, model number, serial number, capacity, voltage requirements, and either full load current or full load volt-amperes. Labels of tested compliances and similar essential data shall be a part of this label or located nearby. All equipment nameplates shall be in an accessible location.

In the event that the installation of equipment renders the manufacturer's nameplate inaccessible, the above information shall be etched onto a laminated plastic nameplate securely fastened to the equipment by no less than two machine screws or by other fastening methods approved by the A-E.

FLASH PROTECTION WARNING

Each piece of new electrical equipment, such as switchboards, parallel switchgear, panelboards, circuit breaker enclosures, control panels, motor control centers, transfer switches, etc. that are likely to require examination, adjustment, servicing or maintenance while energized, shall be field marked in a clearly visible location on the equipment enclosure to warn qualified persons of potential electric arc flash hazards, in accordance with NEC 110.16.

ACCESSIBILITY

Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for the proper installation of his work. He shall cooperate with all other trades whose work is in the same place and shall advise the General Contractor of his requirements. Such spaces and clearances shall be kept to the minimum size required for such installations.

Contractor shall locate all equipment that must be serviced, operated, or maintained in fully accessible positions and shall coordinate with other trades as necessary to meet the workspace requirements of the National Electrical Code. Equipment where such space is required includes switchboards, motor control centers, panelboards, fire alarm control panels, telephone and data terminal panels and cabinets, and similar items.

Minor deviations from Drawings may be made to allow improved accessibility. Submit requests for all changes to the A-E for approval. Relocation of equipment, should such be required to meet NEC workspace requirements, shall be made by the Contractor at no additional cost.

CONCEALED RACEWAY

In general, all raceway or cable wiring methods in finished spaces shall be run concealed in walls, partitions, structural concrete panels, or above ceilings.

Exterior Raceway: Raceway may not be routed on exterior surfaces of the building or across a building roof (either above, below, or within roof insulation) unless specifically indicated on the Drawings.

Raceway Below Concrete Floor Slabs: Raceway may not be routed below concrete floor slabs unless such is specifically shown on the Drawings.

Concealment of raceway and covering of same shall not be done until authorized by the Authority Having Jurisdiction (AHJ). This applies to all interior work and exterior work.

SLEEVES AND PLATES

Contractor shall provide and locate all sleeves and inserts required, or shall be responsible for the cost of cutting and patching required where sleeves and/or inserts were not installed, or where incorrectly located. The Contractor shall be responsible for all drilling required for the installation of his hangers.

Sleeves shall be provided for all raceway passing through concrete, masonry, or tile wall, floor, or overhead deck construction. Sleeves shall be constructed of Schedule 40 black steel pipe unless otherwise indicated on Drawings. Sleeves through concrete beams shall be constructed as indicated on Drawings.

Fasten sleeves securely in walls so that they will not become displaced when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials being forced into the space between raceway and sleeve during construction.

Escutcheon plates shall be provided for all exposed (where permitted) raceway passing through walls and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the raceway. Where plates are provided for pipes passing through sleeves that extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

SUPPORTS, ATTACHMENTS

Contractor shall furnish and install all necessary supports required for all electrical equipment, lighting fixtures, raceway, outlet boxes, panelboards, generators, and for all other equipment furnished under this contract, and shall submit drawings to the A-E for approval before purchase, fabrication, or construction of same.

All equipment, unless otherwise shown, shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature; any attachments that are deemed by the A-E to be insufficient due to reasons of strength, location, quality, or appearance shall be replaced as directed at no additional cost to the Owner.

Framing members shall be standard rolled steel shapes, ASTM A36 steel, except that members welded to main structural member shall be of the same specification as the main structural member.

Framing shall be "simple beam" type with end connections welded or bolted for shear loads. Cantilevers may be used when detailed or specifically approved. Location of supplementary framing shall be subject to approval. Welding, where required, shall be performed by certified welders.

Framing members shall be designed for their actual loads with allowable stresses set forth in the AISC Specifications and the AISC Code, without excessive deflection and with consideration for rigidity under vibration, in accordance with standard structural practices. Supplementary framing, including design loads, member size and location shall be clearly shown on shop drawings.

When supplementary framing is indicated, verify that dimensions are suitable and that framing is structurally adequate for the equipment furnished.

FIRE RATED CONSTRUCTION

The fire rating of all floors, ceilings, and partitions shall be maintained. It is the responsibility of this Contractor provide and install any necessary fire resistive components so that the fire integrity of all fire rated structures supporting or containing items required under Divisions 26-28 will not be diminished by the installation of such items. Where device or junction boxes penetrate any fire rated structure, the boxes shall be located in such a manner as not to reduce the fire rating of the structure. Where the Drawings indicate adjacent boxes or devices in rated partitions that would reduce the fire rating of the partition if unprotected, suitable Listed protection methods shall be used to insure the fire rating of the partition will not be decreased by the proximity of other boxes or penetrations.

Where recessed fixtures are used in fire rated ceilings, suitable construction shall be installed above and around the fixture so that the fire rating of the ceiling is maintained. Refer to Architectural Drawings for fire ratings of ceilings.

Where recessed panelboards, recessed cabinets, or other items are located in a fire rated partition, suitable construction behind and around the item shall be used to maintain the fire rating of the partition.

Where fire resistive insulation or other coverings have been applied to a structure or to structural elements to obtain a fire rating and this insulation or covering is removed or otherwise disturbed by the installation of Division 26-28 components or other related items, this Contractor shall be responsible for restoring the material to a condition that matches the original fire protective ability.

Approval must be obtained from the A-E before any boxes, devices, or other components are relocated for the purpose of maintaining fire ratings.

TESTING LABORATORY APPROVAL

All equipment shall be approved for the intended use and shall be Labeled or Listed. In any case where the suitability for a particular application is in question by the A-E or inspection authorities the Contractor shall furnish appropriate standards covering the specific piece of equipment in question. Such standards, if required, shall be requested by the A-E in writing and shall be furnished by the Contractor at no additional cost.

PERSONNEL GROUND FAULT PROTECTION

Personnel ground fault protection is to be provided for certain receptacles as indicated on the Drawings and/or as required by the National Electrical Code. Protection is to be provided by the use of GFCI receptacles; the use of GFCI circuit breakers is not acceptable for the protection of general use receptacles. GFCI receptacles may not be used to protect other downstream non-GFCI receptacles unless specifically indicated on the Drawings.

If required, use GFCI circuit breakers to protect equipment or dedicated receptacles in locations as indicated on Drawings or panel schedules. GFCI receptacles may not be used to protect downstream circuit components.

TYPICAL MOUNTING HEIGHTS OF DEVICES

Typical mounting heights for electrical equipment shall be as follows unless otherwise noted on Drawings:

DEVICE	MOUTING HEIGHT ABOVE FINISHED FLOOR (AFF)	TO
Panelboards	6'-6"	Top
Toggle Switches	3'-6"	Center Line
Receptacles	1'-6"	Center Line
Telephone Outlets	1'-6"	Center Line
Telephone Cabinets	6'-6"	Top
Telephone Backboards	6'-6"	Top
Safety Switches	5'-6"	Top
Data Outlets	1'-6"	Center Line

SCAFFOLDING, RIGGING, HOISTING

The Contractor shall furnish all scaffolding, rigging, hoisting and related sub-contract services necessary for equipment delivery and final placement as indicated on the Drawings.

All scaffolding, rigging and hoisting equipment shall be removed from the job site in a timely manner when such equipment is no longer required.

EARTHWORK

Excavating and backfilling inside and outside the building shall include shoring and bracing, pumping and protection for safety of persons and property. Backfill shall be compacted in layers not exceeding 6" in depth. Completed backfill shall conform to surrounding ground and finish grade. Restore any sidewalks, roads, or existing work which is cut or damaged to "as found" conditions. Dispose of excess material in a manner approved by the A-E at no additional cost to the Owner.

The Drawings for this project show anticipated underground utilities at locations where they will not interfere with proposed construction. Information on the Drawings concerning existing utilities or other underground services is believed to be accurate and is presented in good faith. Exact locations for such services may be determined only by excavation; extreme caution shall be used with regard to trenching or excavation in the vicinity of underground services. In trenching or other excavation work always assume the presence of undocumented underground services. In the event underground services are damaged by the Contractor the Contractor shall repair same in a manner satisfactory to the A-E at no additional cost to the Owner.

ELECTRICAL CIRCUITS

Circuit designations and connections are shown on the Drawings. Indicated circuit numbers and circuit breaker positions are mandatory unless changes are specifically approved by the A-E in writing.

Electrical neutral connections are indicated on the Drawings. Neutrals may not be reconfigured or otherwise changed without specific approval in writing from the A-E.

Request for circuit or neutral changes **can not be a part of the equipment submittal process.**

EQUIPMENT CONNECTIONS

In general, provide complete electrical power supply system connections to all equipment shown on Drawings. In addition, provide disconnection and re-connection to the power system of any items that are indicated on the Drawings as being moved or relocated.

Control wiring shall be installed in raceways and box system separate from power wiring, unless otherwise indicated on Drawings. Wiring within equipment enclosures shall be in raceways provided under this section of the Specifications unless approved raceway is provided by the manufacturer of the equipment or unless the equipment is listed for use as a raceway.

ELECTRICAL PROVISIONS FOR DIVISIONS 21 - 23

Division 26-28 Contractor shall provide complete power wiring to a disconnecting means provided under Division supplying the equipment. Extension of power from the disconnecting means to the utilization equipment shall be made under the Division supplying the equipment.

Starters, contactors, and similar control equipment shall be furnished and installed by other divisions unless specifically shown on the electrical Drawings. Control wiring is furnished by the Division supplying the control equipment.

Fuses for fused disconnects are furnished and installed by the division supplying the equipment to be protected.

Refer to Sections 210511, ELECTRICAL PROVISIONS FOR FIRE PROTECTION WORK, 220511, ELECTRICAL PROVISIONS FOR PLUMBING WORK and/or 230511, ELECTRICAL PROVISIONS FOR HVAC WORK for a complete description and breakdown of the responsibility of each trade (Divisions 20-23 and Divisions 26-28).

END OF SECTION 260500

SECTION 260519 - SECONDARY VOLTAGE WIRES AND CABLES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of electrical products, of types and ratings required in this Section, whose products are Listed and Labeled for the purpose intended. Subject to compliance with requirements provide devices equivalent to one of the following:

Encore Wire Corporation
General Cable Corporation
Southwire Company
Cerro Wire

Codes and Standards:

NEC Compliance: Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.

Testing Laboratory Compliance: Provide wiring/cabling and connector products that are Listed and Labeled.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on electrical wires, cables and connectors.

PART 2 - PRODUCTS

SECONDARY VOLTAGE WIRES, CABLES, AND CONNECTORS

General: Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information. Connections shall be designed and constructed using connectors as recommended by manufacturer for a complete installation for the application indicated. Provide copper conductors with conductivity of not less than 98% at 68° F.

Building Wires: Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Contractor to comply with project's installation requirements, NEC and NEMA standards. Select from the following Listed types those wires with construction features that fulfill project requirements:

Type THWN/THHN: For general use as interior branch circuits and feeders; maximum operating temperature 90° C (194° F). Insulation, flame-retardant, moisture- and heat-resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.

Type XHHW: For general use as exterior feeders and service entrance conductors, as conductors in all underground raceway, as conductors in wet locations and as specifically indicated on the Drawings; maximum operating temperature 90° C (194° F). Insulation, moisture and heat-resistant cross-linked polymer; conductor, annealed copper.

Building wire shall be installed in raceway for all applications, except as specifically noted below for cables.

Cables: Provide Listed type factory-fabricated cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated for services indicated. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements, NEC and NEMA standards. Select from the following types, those cables with construction features that fulfill project requirements:

Cables may be used as the final leg of branch circuits in sheet rock walls only. Cables may be used above ceiling for lighting whips. All homeruns shall be conductor in conduit. All MC cable shall be color-coded per phase.

Connectors:

General: Provide factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following, those types, classes, kinds and styles of connectors to fulfill project requirements:

Type: Pressure, threaded

Class: Insulated

Kind: Copper (for Cu to Cu connection)

Style: Wirenut, wingnut, power distribution block

Use power distribution blocks or other splicing device having a minimum of one clamping screw per conductor where conductor size or quantity exceed limits for "wirenut" or "wingnut" type connectors.

Provide power distribution blocks that are attached to the gutter, box, or enclosure into which they are installed. Free-floating, unattached power distribution blocks are not acceptable.

Provide suitable insulating covers for all connection devices where such insulation is not a part of the device design.

Use of split bolt connectors, insulation piercing connectors, or tape as a means of insulating connection devices is not acceptable.

PART 3 - EXECUTION

INSTALLATION OF WIRES AND CABLES

General: Install wires and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation," and in accordance with recognized industry practices.

Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work.

Circuits of size #8 AWG and larger shall have Class B stranded conductors.

Power and lighting circuits #10 AWG and smaller shall have solid conductors. The minimum size for all power and lighting circuits shall be #12 AWG.

Control wiring shall have stranded conductors and a minimum size of #14 AWG.

Maximum size for feeders and service conductors shall be 500 kcmil.

Increase Drawing indicated size of conductors for ampacity and temperature rating as described below:

Conductor sizes shown on Drawings are based on the use of terminations Listed and Labeled for use at 75° C. (167° F.). Where terminations are not Listed and Labeled for use at 75° C. (167° F.), the Contractor shall increase the size of the conductor as required to meet the temperature rating of the conductor in accordance with NEC Article 110.14(c). Conductor size increases required under this section shall be made without additional cost.

Increase Drawing indicated size of conductors for voltage drop as follows:

Use #10 AWG conductor for 20 Ampere, 120 Volt branch circuit home runs longer than 50 feet, unless otherwise noted on Drawings.

Use #10 AWG conductor for 20 Ampere, 277 Volt branch circuit home runs longer than 100 feet, unless otherwise noted on Drawings.

Conduit runs shall contain the number of phase conductors shown on the plans. A dedicated neutral shall be installed for each phase conductor served by single pole, 120 and 277 Volt, 20 Amp circuit breakers. Multi-pole circuit breakers serving 120 and 277 Volt, 20 Amp multi-wire branch circuits with a common neutral shall not be permitted. Conduits runs shall contain related grounding and/or isolated grounding conductors.

Conduit runs that contain more than one neutral shall have each neutral conductor uniquely identified at each termination, splice and where routed through junction or pull boxes. Neutral conductors containing a factory applied, trace line along the length that matches the color of the associated phase conductor shall be used to meet this requirement. Machine printed labels with the panel and associated circuit number shall also be permitted for identifying neutral conductors. Colored tape and pre-printed tags shall not be acceptable.

Feeders and/or branch circuits shall not be combined either with each other or one with another into junction boxes, pull boxes, device boxes, manholes, or other common routing unless such routing is specifically indicated on the Drawings.

Neatly train wiring inside boxes, equipment and panelboards; Avoid bundling conductors with lacing or cable ties so that generated heat may be more easily dissipated.

Conduit runs indicated on the Drawings as composed of parallel runs of conductors shall be made identical with respect to length, conduit size, wire type, insulation type, routing, and terminations at each end.

Conductors Shall Be Color Coded as Follows:

Grounding Conductors: Green

Isolated Grounding Conductors: Green with yellow tracer

Grounded Neutral Conductors: White for 120 V systems, gray for 277 V systems

Ungrounded Phase Conductors for 208Y/120V Systems: Black (phase A), red (phase B), and blue (phase C)

Ungrounded Phase Conductors for 480Y/277V Systems: Brown (phase A), orange, (phase B) and yellow (phase C)

Switch Leg Travelers: Violet

Provide other wire colors as indicated on the Drawings.

Remarking of insulation colors by use of colored marker tape shall be permitted only as allowed by the NEC.

Install exposed cables (where permitted) parallel and perpendicular to surfaces, or exposed structural members. Cables shall follow surface contours, where possible.

Completely and thoroughly swab raceway system before installing conductors.

Branch circuit wiring shall not loop through receptacle terminals, but shall be connected by means of conductor taps joined to branch circuit conductors. At end of run, branch circuit conductors may terminate on receptacle screw terminals. Quick make, clamp, or push-in type terminations may not be used to make connections to devices.

Position all splices in pull boxes and junction boxes of adequate volume so they are accessible from the removable cover side of the box.

Conductors for signal systems shall be continuous (without splice) and shall be terminated on terminal strips or terminate in a manner approved by the system's manufacturer.

All neutrals and ground wires in panels shall be labeled with cloth wire markers to indicate the circuits being served.

Pull conductors simultaneously where more than one is being installed in same raceway.

Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation. After conductors have been pulled, clean exposed conductors and surrounding area to remove all evidence of the use of pulling compound.

Use pulling means including fish tape, cable, rope and basket weave wire/cable grips that will not damage cables or raceway.

Keep conductor splices to a minimum.

Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

Use splice and tap connectors that are compatible with conductor material.

Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.

WIRING CONNECTIONS AND TERMINATIONS

Splices shall be permitted on conductors up to #4 AWG. No splices shall be permitted on conductor #3 AWG and larger without specific approval in writing by the A-E. Splices shall be made in accessible junction boxes; no splices shall be made in conduit bodies.

Splices, taps, and attachments of fittings and lugs shall be electrically and mechanically secure. Connectors and lugs shall be proper size and labeled as suitable for the number and type of conductors joined.

Solid conductors, namely those sized #10 and #12 AWG copper shall be spliced or tapped only by the use of Ideal "Wing-Nuts" or "Wire Nuts", Buchanan's "B-Cap" or 3M Co.'s "Scotchlox" connectors. "Sta-Kon" or other permanent type crimp connectors shall not be used.

Self-stripping electrical pigtail and tap connectors shall not be used.

Stranded conductors, namely #8 AWG to #4 AWG, shall be spliced or tapped by approved mechanical connectors. Insulation for splices or taps shall be obtained by the use of Listed insulating covers designed for use with the particular connector. Quality of insulation at splices shall equal that of the conductor insulation in terms of temperature resistance, covering ability and durability.

Conductors, in all cases, shall be continuous from outlet to outlet, and no splicing shall be made except within outlet or junction boxes, troughs, and gutters. No splices shall be permitted in panel enclosures, disconnects or utilization equipment.

Lugs for conductors #8 through #4 AWG shall be copper, with a direct acting screw. Where permitted, lugs for conductors #3 AWG and larger shall be copper, applied directly to the cable by hydraulic pressure. Lugs shall not be split bolt or screw types.

Tape, where used, shall be made using special oil resistant vinyl plastic tape that is Listed, rated 105° C.

Splices or taps in grounding conductors (where permitted) in sizes #8 AWG and larger shall be by means of exothermic welding and termination shall be by means of approved grounding connectors. As an alternate, connectors using hydraulic compression tools may be used as a contractor selection option. Solder shall not be used as a means of joining grounding conductors.

Thoroughly clean wires before installing lugs and connectors.

Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

Terminate spare conductors with electrical tape.

FIELD QUALITY CONTROL

Prior to energizing circuitry, check installed wires and cables with megohm meter to determine insulation resistance levels to insure requirements are fulfilled. Provide additional testing as directed by the A-E in accordance with Section 260800, *TESTING AND PLACING IN SERVICE*.

Prior to energizing circuitry, test wires and cables for electrical continuity and for short circuits. Verify proper phasing connections.

Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 260519

SECTION 260526 - GROUNDING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturer's Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, grounding rods, and bonding jumpers whose products are Listed and Labeled for their intended usage.

Codes and Standards:

Electrical Code Compliance: Comply with applicable State electrical code requirements and the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.

Testing Laboratory Compliance: Comply with applicable requirements of UL Standards No.'s 467, "Electrical Grounding and Bonding Equipment," and 869, "Electrical Service Equipment," pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products that are Listed and Labeled for their intended usage.

IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 01 99 13. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on grounding and bonding products and associated accessories.

PART 2 - PRODUCTS

GROUNDING AND BONDING SYSTEMS

Materials and Components:

General: Except as otherwise indicated, provide electrical grounding and bonding systems indicated, assemble materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding rods, bonding jumpers, service arresters, and additional accessories as needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Contractor's option. Where materials or components are not indicated, provide products that comply with NEC and UL requirements and with established industry standards for those applications indicated.

Conductors: Unless otherwise indicated, provide equipment grounding conductors in all conduit and wiring systems. Grounding conductors shall be insulated by the same type insulation as the ungrounded conductors and sized in accordance with NEC Table 250.122 unless otherwise specified.
Bonding Connectors, Terminals and Clamps: Provide electrical bonding connectors, terminals, lugs and clamps as recommended by bonding connector, terminal and clamp manufacturers for indicated

applications.

Ground Rods: Provide rods made of steel with copper welded exterior, 3/4" diameter by 10 feet.

Ground Bus Bars: Provide copper bus bars mounted on standoff insulating bushings.

Hardware: Provide hardware for all grounding and bonding applications that consist of Type 300 series stainless steel, silicon bronze or brass. Hardware used for connections to enclosures shall include flat washers and split lock washers.

Electrical Grounding Connection Accessories: Provide electrical insulating tape, bonding straps, as recommended by accessories manufacturers for type service indicated.

PART 3 - EXECUTION

EXAMINATION

Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify A-E in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

General: Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements.

Install grounding systems as designed and submit certified test report on grounding system.

Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.

Ground electrical service system neutral at service entrance equipment to grounding rod(s), grounded copper water pipe, and building steel where effectively grounded. All ground corrections shall be accessible. Provide additional bonding connections to miscellaneous metallic piping systems entering the building such as fire protection and gas piping.

Provide an intersystem ground bus bar adjacent service equipment as shown on the drawings.

Ground each separately-derived system neutral to:

Effectively grounded copper water pipe

Building structural steel

Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold-water systems.

Install direct burial type ground clamps for grounding electrode conductors to underground grounding rods.

Provide a separate, insulated equipment grounding conductor from each device to ground buses in panelboards. Terminate each end on a grounding lug, bus, or insulated grounding bushing.

Provide separate insulated equipment grounding conductor, size to be determined from NEC Table 250.122, for each circuit and in each conduit run. The grounding conductor shall be attached by means of a dedicated green screw to a common point in each junction box, cabinet, device box, enclosure, or utilization equipment to which it runs or through which it passes. Grounding methods depending on the continuity of electrical raceway, clips, or mounting screws are not acceptable. This grounding requirement will be rigidly enforced.

Connect grounding electrode conductors to copper water pipe using a suitable grounding clamp as indicated on drawings. Provide conduit grounding hubs and water pipe ground clamps as required.

Provide copper grounding conductor from supplemental ground bus bar adjacent service equipment to communications (telephone/data or cable TV) backboards where shown on drawings. Terminate conductor on insulated ground bus bar for use by others.

Provide an insulated bonding bushing on all panelboard feeders. Terminate feeder equipment grounding conductor by passing the conductor through the terminal of the insulated bonding bushing and then onward to terminate at the panel ground bus.

Provide an insulated bonding bushing at boxes, enclosures or cabinets with concentric, eccentric or over-sized knockouts. Terminate equipment grounding conductor by passing the conductor through the terminal of the insulated bonding bushing and then onward to terminate at ground bus or lug.

Connect grounding electrode conductors to 1-inch diameter, or greater, metallic cold-water pipe using a suitably sized ground clamp.

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed.

Install clamp-on connectors on clean metal contact surfaces to ensure electrical conductivity and circuit integrity.

Sectionalizing switchgear housing, cable shielding and primary grounding conductors shall be connected to a driven copper ground rod having a maximum resistance of 25 Ohms by means of # 3/0 AWG bare copper stranded conductor.

Service transformer housing, cable shields, primary and secondary neutrals shall be connected to a driven copper ground having a maximum resistance of 25 Ohms using # 3/0 AWG bare stranded copper conductor. Primary neutral conductor shall be unbroken to transformer primary neutral bushing, and thereafter grounded as indicated on the Drawings.

FIELD QUALITY CONTROL

Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 25 Ohms, take appropriate action to reduce resistance to 25 Ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

Provide written certified testing report indicating resistance-to-ground value.

END OF SECTION 260526

SECTION 260529 - SUPPORTING DEVICES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification section, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings required.

Codes and Standards:

NEC Compliance: Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.

Testing Laboratory Compliance: Provide electrical components that are Listed and Labeled.

ANSI Compliance: Comply with ANSI/MSS SP-69, Hangers and Supports – Selection and Application for selecting electrical supporting devices.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve and seal.

PART 2 - PRODUCTS

MANUFACTURED SUPPORTING DEVICES

General: Provide supporting devices as herein specified which comply with manufacturer's standard materials, design and constructed in accordance with published product information and as required for complete installation. Where more than one type of supporting device meets indicated requirements, selection is Installer's option.

Supports: Provide supporting devices of types, sizes and materials indicated that have the following construction features:

Clevis Hangers: For supporting large rigid metal conduit hangers shall be steel with finish appropriate for application and 1/2" diameter hole for round steel rod. Approximate weight is 54 pounds per 100 units.

Reducing Couplings: Steel rod reducing coupling shall be 1/2", 3/8" or ¼" x 5/8" steel, with finish appropriate for application.

C-Clamps: C-clamps shall be ductile iron, with finish appropriate for application and 1/2", 3/8" or ¼" rod size. Approximate weight is 50 pounds per 100 units.

I-Beam Clamps: I-beam clamps shall be steel, with finish appropriate for application. 1-1/4" x 3/16" stock with 3/8" cross bolt. Flange width shall be 2". Approximate weight is 52 pounds per 100 units.

Conduit Hangers: Hangers shall be galvanized steel used for supporting conduit up to 2". Weight varies with conduit size, up to 25 pounds per 100 units for 2" trade size.

One-Hole Conduit Straps: One hole conduit straps used for supporting 1/2" conduit (where such is permitted) and 3/4" conduit, shall be galvanized steel. Approximate weight is 7 pounds per 100 units.

Two-Hole Conduit Straps: Two hole conduit straps, used for supporting conduit larger than 3/4", shall be galvanized steel. Weight varies with conduit size.

Hexagon Nuts: For 1/2", 3/8" or ¼" rod sizes, nuts shall be galvanized steel.

Round Steel Rod: Use black steel for 1/2", 3/8" or ¼" diameter rod.

Anchors: Provide anchors of types, sizes and materials indicated, with the following construction features:

Lead Expansion Anchors: 1/2", approximately 38 pounds per 100 units.

Toggle Bolts: Springhead type, 3/16" x 4", approximately 5 pounds per 100 units.

Powder actuated anchors and fasteners are not permitted.

Watertight Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals of types and sizes indicated. Wall and floor seals shall be suitable for sealing around conduit, pipe, or tubing passing through concrete walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment and conduit where runs of more than two conduit must be supported from overhead structure. System shall be 12-gage minimum hot-dip galvanized steel of types and sizes indicated. Use 1 1/2" deep channel to support conduit larger than 1 1/2" trade diameter. Furnish with the following fittings that mate and match with U-channel:

Channel hangers

End caps

Beam clamps

Wiring studs

Thinwall conduit clamps

Rigid conduit clamps

Conduit hangers

U-bolts

FABRICATED SUPPORTING DEVICES

Pipe Sleeves: Provide pipe sleeves as follows:

Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

Sleeve Seals: Provide sleeves for piping which penetrates foundation walls below grade, or exterior walls. Caulk between sleeve and pipe with non-toxic, UL classified caulking material to ensure watertight seal.

PART 3 - EXECUTION

INSTALLATION OF SUPPORTING DEVICES

Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.

Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

Install hangers, supports, clamps and attachments to support conduit properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.

Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form water tight seal.

END OF SECTION 260529

SECTION 260533 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of electrical identification products, of types required.

Codes and Standards:

NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.

UL Compliance: Comply with applicable requirements of UL Std. 969, "Marking and Labeling Systems," pertaining to electrical identification systems.

NEMA Compliance: Comply with applicable requirements of NEMA Std. No's. WC-1 and WC-2 pertaining to identification of power and control conductors.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 01 99 13. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on electrical identification materials and products.

Label Wording: Submit exact wording for approval prior to the construction of laminated nameplates or specialized signs. Submittal shall show both proposed wording and physical layout of each label, including mounting holes.

PART 2 - PRODUCTS

ELECTRICAL IDENTIFICATION MATERIALS

General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

Engraved Plastic-Laminate Signs:

General: Provide engraving stock melamine plastic laminate, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated or as required to properly identify items installed under this division.

Color scheme shall be as indicated herein or on the Drawings. Signs shall be punched for mechanical fastening.

Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.

Fasteners: Self-threading, blunt end, stainless steel machine screws.

Color-Coded Plastic Tape:

General: Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils. thick by 1-1/2" wide. Tape shall be listed for use at 105°C. or the temperature rating of the conductors to be marked, whichever is higher.

Cable/Conductor Identification Bands:

General: Provide pre-numbered or pre-lettered manufacturer's standard cloth self-adhesive cable/conductor markers of wrap-around type. Printing shall show circuit identification by indicating panel designation and circuit number.

Underground Type Plastic Line Marker:

General: Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct burial service, not less than 6" wide x 4 mils thick. Provide electrically conductive tape with printing which most accurately indicates type of service of buried conduit or cable.

Place line marker 6" to 8" below finished grade and directly above line to be protected. For multiple conduit or cable runs in the same trench, use multiple line markets, one above each conduit or cable.

Baked Enamel Danger Signs:

General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel. Signs shall be of standard red, black, and white graphics, 14" x 10" size. Where larger size exceeds space available, the 10" x 7" size may be used. Signs shall have recognized standard explanation wording, such as, “HIGH VOLTAGE,” “KEEP AWAY,” “BURIED CABLE,” “DO NOT TOUCH SWITCH,” etc.

Code-Colored Conduit Markers:

General: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, for feeders extending 360 degrees around conduits. Markers shall be designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pre-tensioned snap-on. Except as otherwise indicated, provide lettering that indicates voltage of conductor(s) in conduit. Provide 8" minimum length for 2" and smaller conduit, 12" length for larger conduit.

Colors: Unless otherwise indicated on the Drawings or required by governing regulations, provide white markers with black letters.

LETTERING AND GRAPHICS

General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment.

WIRE COLOR CODE SCHEDULE

Where more than one nominal voltage system exists within a single facility, a schedule of conductor color codes shall be posted at each panelboard that is installed, relocated, renovated, or otherwise modified. The schedule, meeting the requirements of NEC 210.5(C) for branch circuit panelboards, shall be permitted to be either a plastic laminate sign or a printed label with permanent self-adhesive containing the information given in Section 260519, *SECONDARY VOLTAGE WIRES AND CABLES*. The label shall be installed so that it is clearly visible with the panelboard cover removed but with any shields or protective barriers in place. The label shall be installed after the installation of all conductors so that it may be located in an un-obscured location.

SERVICE EQUIPMENT AVAILABLE FAULT CURRENT LABEL

Based on the short circuit study conducted by the engineer for the distribution system, the Contractor shall prepare a phenolic field label to identify the available fault current at service equipment. This label shall be consistent with the requirements of this Section, with respect to color scheme and size. The label shall clearly indicate the date in which the calculation was prepared, as indicted by the engineer.

PART 3 - EXECUTION

APPLICATION AND INSTALLATION

General Installation Requirements:

Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC.

Coordination: Where identification is to be applied to surfaces that require finish, install identification after completion of painting.

Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

Conduit and Box Identification:

General: Apply color-coded identification to match system color code on electrical conduit and junction boxes in accordance with the following:

All empty conduit runs and conduit with conductors for future use shall be identified for such use; identification shall indicate where such conductors or empty conduct terminates. Identification shall be by tags attached to the pull cord or spare conductors. Each end of the pull cord shall be identified.

All outlet boxes, junction boxes and pull boxes, either exposed or concealed, shall have their covers and exterior visible surfaces painted with the field colors described in this section. Boxes shall also be marked to indicate the panelboard and circuit number(s) of the circuits contained within. Lettering may be by hand for concealed or non-public locations only. Machine printed labels are to be used to identify boxes where such are permitted to appear in areas accessible by the public; embossed type plastic labels are not acceptable for use on this project. Where hand produced marking is permitted, the lettering shall be made with waterproof ink.

Equipment/System Identification:

General: Install an engraved plastic laminate sign on each major unit of electrical equipment on project. Such equipment includes central or master unit of each electrical system including communication, control, and signal systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, 1/2" high lettering, on 1-1/2" high sign (2" high where 2 lines are required), white lettering in field color as indicated below. Provide text matching terminology and numbering of the Contract Documents and shop drawings.

Field Colors shall be the following:

Blue surface with white core for 120/240 Volt equipment.
Bright red surface with white core for all equipment related to fire alarm system.
Dark red (burgundy) surface with white core for all equipment related to security.
Yellow surface with black core for all equipment related to optional stand-by systems.
Orange surface with white core for all equipment related to telephone systems.
Brown surface with white core for all equipment related to data systems.

Provide Signs for Each Unit of the Following Categories of Electrical Work:

- Panelboards, electrical cabinets and/or enclosures
- Disconnect or safety switches
- Pushbuttons
- Transformers
- Fire alarm master stations

Cable/Conductor Identification (Low Voltage):

General: Apply cable/conductor identification, including feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

Cable/Conductor Identification (High Voltage):

General: Apply cable identification, including feeder number and phase identification, on each cable in each box, manhole, handhole, enclosure, and/or cabinet where high voltage cables are present. Use of color-coded tape to identify phases is acceptable provided this identification is accompanied by feeder identification attached to each cable.

Match identification with marking system used elsewhere in the Contract Documents. Identification means used on high voltage cables shall be waterproof and shall not deteriorate when used in a wet environment.

Underground Cable Identification:

General: During backfilling/top soiling of each exterior underground conduit, install continuous underground type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Install line marker for all buried conduits.

Optional Identification and Warnings:

General: Install self adhesive plastic signs or similar equivalent identification wherever reasonably required to prevent misuse by unauthorized personnel or to ensure safe and efficient operation and maintenance of electrical systems, electrically connected mechanical systems, and general systems and equipment. Install self-adhesive plastic signs or similar equivalent identification giving instruction or warnings on switches, outlets, controls, or devices where instructions or explanations are needed. Provide plasticized tags with clearly written messages adequate for intended purposes.

END OF SECTION 260533

SECTION 260534 - RACEWAYS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products are Listed and Labeled.

Codes and Standards:

NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.

Testing Laboratory Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components that have been Listed and Labeled.

NEC Compliance: Comply with applicable requirements of the latest edition of the NEC pertaining to construction and installation of raceway systems.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 01 99 13. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating that materials comply with requirements.

PART 2 - PRODUCTS

METAL CONDUIT AND TUBING

General: Provide metal conduit, tubing and fittings of types, grades, sizes, and weights (wall thicknesses) for each use indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements as stated herein while complying with applicable portions of NEC for raceways.

Rigid Metal Conduit (RMC): Provide rigid steel, zinc-coated, threaded type conforming to ANSI C80.1 and UL 6. Provide zinc coating fused to inside and outside walls.

Electrical Metallic Tubing (EMT): Provide electrical metallic conduit conforming to ANSI C80.3 and UL 797.

Flexible Metal Conduit (FMC): Provide steel flexible metal conduit conforming to UL 1. Conduit shall be formed from continuous length of spirally wound, interlocked zinc-coated strip steel.

Liquid-Tight Flexible Metal Conduit (LFMC): Provide flexible liquid-tight metal conduit constructed of single strip, flexible, continuous, interlocked, and double-wrapped steel. Inside and outside shall be galvanized; conduit shall be coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).

Rigid Metal Conduit Fittings: Provide cast malleable iron, galvanized or cadmium plated.

Use Type 1 fittings for raintight connections.
Use Type 2 fittings for concrete tight connections.

Conduit Locknuts: Provide case-hardened steel locknuts for use on threaded raceway.

Conduit Bushings:

Insulated: Provide Listed and Labeled, threaded, thermosetting plastic bushings at each end of all threaded raceway. Provide grounding type if same is indicated elsewhere.

Grounding (bonding type): Provide Listed and Labeled, threaded, insulated throat, bonding type bushings. Provide steel frame bushings for use on ferrous raceway. Provide bushings with tin-plated copper grounding saddle sized to accept grounding conductor size as indicated on the Drawings. Where grounding conductors are oversized, provide separate copper grounding lugs that are appropriately sized.

Flexible Metal Conduit Fittings: Provide steel conduit fittings for use with flexible steel conduit of threadless hinged clamp type. All flexible metal conduit fittings shall be Listed as suitable for grounding.

Straight Terminal Connectors: Provide insulated throat type, one piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with steel locknut.

45° or 90° Terminal Angle Connectors: Provide steel insulated throat type, two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with steel locknut.

Liquid-Tight Flexible Metal Conduit Fittings: Type 1, Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat and steel locknut. All liquid tight flexible metal conduit fittings shall be Listed as suitable for grounding.

EMT Fittings:

EMT Conduit Couplings: Cadmium plated steel, dual compression type with two (2) hexagon compression fittings. Fittings that can not be tightened with an open-end wrench of the appropriate size are not acceptable.

EMT Conduit Connectors: Cadmium plated steel, insulated throat, compression type with hexagon compression fitting and steel locknut. Fittings that can not be tightened with an open-end wrench of the appropriate size are not acceptable.

Unacceptable fitting types: Pot metal, set screw, and indenter type fittings, or connectors that do not have insulated throats, are not acceptable for use on this project.

Conduit Bodies: Provide galvanized steel conduit bodies of types, shapes and sizes as required to fulfill job and NEC requirements. Conduit bodies shall be constructed with threaded conduit entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.

Metallic Conduit, and Tubing Accessories: Provide metallic conduit and tubing accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

WIREWAYS

General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of wireway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other components and accessories as required for a complete system.

SURFACE METAL RACEWAY

General: Provide galvanized steel surface metal raceways with snap-on covers of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of surface metal raceways including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other components and accessories as required for a complete system.

Type 1 Raceway: ½" x 5/8" two-piece assembly in lengths as indicated, furnished in standard factory tan enamel finish.

Type 2 Raceway: 3/4" x 5/8" two-piece assembly in lengths as indicated, furnished in standard factory tan enamel finish.

Boxes for Surface Metal Raceway: Provide boxes for surface metal raceway as required to match required devices and outlets. All boxes for surface metal raceway shall be designed, manufactured, and supplied by raceway manufacturer for use with specified raceway.

PART 3 - EXECUTION

INSPECTION

Examine areas and conditions under which raceways are to be installed, and substrate that will support raceways. Notify A-E in writing of conditions detrimental to proper completion of the Work. Do not proceed with work until unsatisfactory conditions have been corrected.

SELECTION OF RACEWAY AND SIZE OF RACEWAY SYSTEM

General: Install concealed raceway system in new construction work, either in walls or above hung ceilings.

Do not route raceway below slabs unless such routing is specifically indicated on the Drawings.

Do not use surface metal raceway unless such use is specifically indicated on the Drawings.

Conduit Installation: Unless otherwise indicated on the Drawings, provide rigid steel zinc-coated conduit (RMC) where embedded in concrete, masonry, earth, or installed outdoors. Follow minimum requirements in other areas as follows:

Steel zinc-coated EMT may be installed in all areas except where specifically indicated otherwise in the Drawings or under the conditions of use listed below:

- Where it will be installed in exterior walls.
- Where it will be installed outdoors, in concrete or in direct contact with the earth.
- Where it will be subject to physical damage.
- Where it will be installed lower than four (4) feet from finished floor in areas where exposed to possible damage from area use activities.
- Where it will be subject to corrosive influence.
- Where it will be installed indoors in wet or damp locations.
- Where trade size is larger than 2".

Any of the above use conditions may be overridden by the Drawings.

Avoid use of dissimilar metals throughout system to reduce the possibility of galvanic action. Where dissimilar metals must be in contact, coat surfaces with corrosion inhibiting compound before assembling.

Use liquid-tight flexible metal conduit (LFMC) only where specifically indicated on the Drawings or where subjected to one or more of the following conditions:

- Flexible connection in an exterior location.
- Final 18" connection to motors.
- Equipment subject to movement or vibration.

Do not use PVC raceway unless such use is specifically indicated on the Drawings.

Use Flexible Metal Conduit (FMC) only for final connections to light fixtures and utilization equipment. Any other use shall be limited to applications where specifically indicated on the Drawings

Flexible Metal Conduit may not be used to interconnect device or junction boxes, utilization equipment, fixtures.

Flexible Metal Conduit length shall not exceed six feet.

Size raceway and raceway systems as follows:

Size raceway to meet NEC requirements, or as indicated on the Drawings, whichever size is larger, except no conduit smaller than 3/4-inch trade size shall be installed.

INSTALLATION OF RACEWAY SYSTEMS

General: Install raceways as indicated, in accordance with manufacturer's written installation instructions, and in compliance with the NEC and NECA's "Standards of Installation." Install raceway and related boxes and fittings plumb and level, ±2°. Maintain manufacturer's recommended clearances.

Fasten heavy wall conduit terminations in sheet metal enclosures by two locknuts, one inside and one outside of enclosure, and terminate with insulated bushing; terminate other conduit systems with connectors listed for the purpose and as described above.

Conduit couplers shall be steel threaded type in all locations where such use is possible. Otherwise use 3-piece union.

Conduits are not to cross pipe shafts or ventilating duct openings. Conduit is not to be routed in elevator shafts unless necessary to serve items within the shaft.

Keep conduits a minimum distance of 6" from parallel runs of hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water piping.

Support riser conduit at each floor level with clamp hangers.

Use of running threads at conduit joints and terminations is prohibited. Where required, use threaded nipples and 3-piece unions.

Support exposed conduit by use of hangers, clamps or clips Listed for the purpose. Support conduit on each side of bends and on spacing not to exceed following:

- Rigid Metal Conduits Up to 1": 8'-0".
- Rigid Metal Conduits 1-1/4" and Over: 10'-0".
- EMT Up to 1": 8'-0".
- EMT 1-1/4" and Over: 10'-0".

Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers Listed for the purpose. Requirements for exposed conduits also apply to conduits installed in space above hung ceilings.

Concealed Conduits:

- Metallic raceways installed underground, in floors below grade (where permitted), or outside are to have conduit threads painted with corrosion inhibiting compound before couplings are assembled. Draw up coupling and conduit sufficiently tight to ensure a watertight joint.
- For floors-on-grade (where permitted), install conduits under crushed rock and concrete slabs.
- Install underground conduits 24" below finished grade (24" cover) as a minimum or as otherwise indicated on the Drawings if a greater depth is shown.

Exposed Conduits:

- Install conduits in a manner so as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.
- Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.
- Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets. Coordinate conduit installation with other trades as required.
- Install exposed conduit directly on structure using two-hole straps. Provide offsets at all boxes and as required to avoid exiting utilities.
- Conduits installed on interior of exterior walls shall be spaced off the wall surface a minimum of ¼ inch with appropriate straps.

Run conduits for outlets on waterproof walls exposed where indicated on the Drawings. Set anchors for supporting conduit on waterproof wall in waterproof cement. Requirements for exposed conduit also apply to conduits installed in space above hung ceilings.

Raceway Fittings: Install connectors, couplers, and related fittings as required for a complete raceway system.

Install insulated bushings for terminating all types of raceway where termination is not made with an insulated throat connector.

Where concentric, eccentric, or over-sized knockouts are encountered, a grounding-type insulated bushing shall be provided. Bushing shall be connected to the equipment grounding conductor.

Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, and plugs are to be constructed from steel and specifically designed and Listed for their particular application.

Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.

Mechanically fasten together metal conduits, enclosures, and other components comprising raceway system to form a continuous electrical conductor. Connect to electrical boxes, fittings, and cabinets to provide electrical continuity and firm mechanical assembly.

Raceway must be installed as a complete system prior to the installation of cables, conductors, or pull wires into any part of the systems.

Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200' linear run maximum and wherever structural expansion joints are crossed.

Use roughing-in dimensions of electrically supplied utilization equipment furnished by supplier or by other divisions as appropriate. Set conduit and boxes for connection to units only after receiving review of dimensions and after verification of location with other trades.

Do not set final connections for fixtures and/or utilization equipment until connection points and requirements are accurately known. The Contractor is responsible for the relocation of mis-located connection points as required to match equipment at no additional cost.

Cut conduits straight, properly ream. Threads shall be cut into heavy wall conduit using equipment designed for the purpose.

Make changes in direction of raceway run by means of proper field bends or with proper fittings, supplied by raceway manufacturer.

Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported for lengths in excess of the maximum support distance as previously specified. Raceways may not be used to support other raceways or other items of equipment.

Arrange conduit to maintain headroom and present a neat appearance.

Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

Group raceway in parallel runs where three (3) or more raceway are routed together. Use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25% additional conduit.

Do not fasten and/or hang conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used during construction for temporary conduit support.

Bring conduit to the shoulder of fittings and couplings and fasten securely. All raceway shall be cut to proper length so ends fit accurately in connectors or couplers.

Use conduit hubs for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.

Use conduit bodies to make sharp changes in direction, as around beams.

Use hydraulic one-shot conduit bender for all field bends in conduit. All field made conduit bends shall meet minimum bending radius requirements of the NEC. Bends in metallic conduit shall be made while "cold". Factory made conduit sections may be used in lieu of field made bends for conduit larger than 2".
Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

Where raceways penetrate walls or partitions separating spaces with differing environmental conditions, such as freezers, coolers, and exterior walls, provide an internal seal to prevent condensation within the raceway as it enters the conditioned space.

Where conduit penetrates fire rated partitions, provide penetration protection in accordance with the UL through-penetration detail indicated on the Drawings for the type of partition and conduit involved. All instructions furnished with firestopping materials shall be followed explicitly.

Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket. All pitch pockets shall be absolutely watertight; once conduit has been routed thought a pitch pocket the water integrity of the pitch pocket is the responsibility of the Division 26-28 Contractor.

Combining of circuits into raceway systems other than indicated on Drawings shall not be permitted.

Bolts, clamps, screws, and expansion bolts shall be used in securing conduit, equipment, etc. Holes for lead shields or other anchors shall be the size recommended by the fastener manufacturer and shall be completely covered by the mounted item. Holes used for support of conduit on brick or block walls shall be located in mortar joints where such location is possible.

Provide nylon pull string in empty conduits where indicated, including conduit placed for telephone and data use. Conduit installed but left empty (with pull string) shall be tested with a ball mandrel. Clear any conduit that rejects ball mandrel. Any costs involved for restoration of conduit and surrounding surfaces to original condition are the responsibility of the Contractor.

INSTALLATION OF SURFACE RACEWAY AND WIREWAYS

General: Use surface raceway or wireway only where specifically permitted in the Drawings.

Mechanically assemble metal enclosures and raceways for conductors to form continuous electrical conductor and connect to electrical boxes, fittings, and cabinets as to provide effective electrical continuity and rigid mechanical assembly. Use flat-head screws to fasten channel to surfaces; mount plumb and level. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

Maintain proper mechanical continuity between raceway components to provide a continuous, effective grounding path.

Avoid use of dissimilar metals throughout system to reduce the possibility of galvanic action. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembly.

Install expansion fittings in all raceways and wireways wherever structural expansion joints are crossed.

Use boxes as supplied by raceway or wireway manufacturer wherever junction, pull or devices boxes are required. Standard electrical "handy" boxes, *etc*. shall not be permitted for use with surface raceway installations.

END OF SECTION 260534

SECTION 260535 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types, sizes, and capacities required, whose products are Listed and Labeled.

Codes and Standards:

NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.

Testing Laboratory Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings that are Listed and Labeled.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 01 99 13. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on electrical boxes and fittings.

PART 2 - PRODUCTS

FABRICATED MATERIALS

Aluminum products are not acceptable for use on the project.

Outlet Boxes: Provide galvanized coated flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable or conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes for attachment of grounding conductor and cover plate or device attachment fittings.

Provide waterproof outlet boxes where box is installed in an outdoor location or in a wet location as defined by the NEC.

Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes. Supplied items shall be compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliance option.

Device Boxes: Provide galvanized coated flat rolled sheet-steel device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Unless otherwise specified device boxes shall be 4" square by 2 1/8” deep, flush mounted, and furnished with suitable plaster ring for the type devices to be used and of a depth to match the type of construction involved. Device boxes shall have ¾" knockout openings in bottom and ends, and with threaded screw holes in the rear for attachment of a grounding conductor. All fasteners shall have a corrosion resistant finish.

Where more than two devices are ganged together at a single location provide gangable device boxes with suitable

partitions, conduit knockouts and attachment hardware.

Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliance option.

Where device boxes are surface mounted (as may permitted elsewhere) use cast steel type 'FS' boxes. Raintight device boxes shall have threaded conduit holes for the attachment of electrical conduit, cast-metal face plates with spring-hinged watertight caps suitable configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. Boxes provided under this section shall have a threaded internal grounding conductor attachment point.

Device boxes exposed to outdoor or wet locations shall be flush mounted and shall be equipped with cast steel covers that are designed to exclude water when closed.

Provide covers that are suitable for use in wet location with device attached if such use is indicated on the Drawings.

Where flush mounting is not possible or not practicable due to the location of the device, provide surface mounted cast steel type 'FS' boxes as described elsewhere.

Junction boxes with no more than 4 entries of ¾" conduit containing conductors no larger than #12 may be 4" square by 2 1/8" deep with ¾" knockouts, threaded hole for connection of grounding conductor and threaded holes for the attachment of a blank cover plate. Provide suitable blank cover plate. Box extensions shall not be used to obtain more volume in 4" square junction boxes.

If box volume is not sufficient, the contractor may, as a code compliance option, may use 4 11/16" square by 2 1/8" deep boxes with ¾" knockouts, threaded hole for connection of grounding conductor and threaded hoses for the attachment of a blank cover plate. Provide suitable blank cover plate. Box extensions shall not be used to obtain more volume in 4 11/16" square junction boxes.

Use fabricated junction boxes as described below if box volumes that can be obtained by the use of 4" square or 4 11/16" square boxes are not sufficient to meet NEC minimum volume requirements.

Junction and Pull Boxes: Provide as required galvanized code-gage sheet steel junction and pull boxes, no knockouts, Listed, with screw-on covers. Types, shapes, and sizes of junction and pull boxes shall be suitable for each respective location and installation. Boxes shall have welded seams and shall be equipped with stainless fastening hardware. Provide steel barriers in boxes with multiple feeder circuits.

Auxiliary Wireways: Construct as required in accordance with UL 870, with Listed and Labeled components.

Construction: 16-gage galvanized sheet metal parts for 4" x 4" to 6" x 6" sections, and 14-gage parts for 8" x 8" and larger sections. Provide wireways with no knockouts.

Finish: Provide 14-gage and 16-gage galvanized sheet metal parts. Plate hardware to prevent corrosion.

In outdoor or wet locations provide wireways that are NEMA 3R. Do not use gaskets that can rip or tear during installation or would otherwise compromise raintight capability of the wireway.

Do not use cover screws that will protrude into the trough area and damage wire insulation.

Size of device, outlet, junction, pull boxes, gutters, and similar components shall be as required to match the number of devices and/or conductors contained within as based on the requirements of NEC Article 314.16.

Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit insulated bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

Floor Boxes for Equipment Connection: Provide cast-iron raintight adjustable single gang floor boxes in locations as indicated. Boxes shall have threaded-conduit entrance ends, vertical adjusting rings, gaskets, and floor plates with raised screw-on covers suitable for minimum 3/4" conduit connection. Cover plate flange shall be suitable for the floor finish installed in locations as indicated. Cover plate, flange and screws shall be brushed aluminum finish.

Floor Boxes for Devices: Provide cast-iron raintight adjustable concealed service floor boxes suitable for concrete or wood floors in locations as indicated. Sheet metal floor boxes are not acceptable. Boxes shall be rectangular with appropriate partitions, threaded-conduit entrance ends, vertical adjusting rings, and gaskets. Cover plate flange shall be suitable for the floor finish installed in locations as indicated. Cover plate, flange and screws shall be brushed aluminum finish. Floor box shall accommodate quantity of power and telephone/data receptacles as indicated below and/or on the Drawings. Conduit connection sizes and quantities shall be coordinated with devices specified.

Floor Boxes for Electrical/IT Devices: Provide fire rated poke-thru adjustable floor boxes in locations as indicated. Boxes shall have threaded-conduit entrance ends, vertical adjusting rings and gaskets. Floor box shall accommodate quantity of power and telephone/data receptacles as indicated below and/or on the Drawings. Cover plate flange shall be suitable for the floor finish installed in locations as indicated. Cover plate, flange and screws shall be brushed aluminum finish.

Floor Boxes for Electrical/IT/AV Devices: Provide stamped sheet metal, fire classified, adjustable, concealed service floor boxes suitable for concrete floors in locations as indicated. Boxes shall be rectangular with appropriate partitions, threaded-conduit entrance ends, vertical adjusting rings, and gaskets. Cover plate flange shall be suitable for the floor finish installed in locations as indicated. Cover plate, flange and screws shall be brass finish. Floor box shall accommodate quantity of power, telephone/data and AV devices as indicated below and/or on the Drawings. Conduit connection sizes and quantities shall be coordinated with devices specified. Provide floor pan assembly for maintaining fire rating of floor assembly for larger boxes in elevated slabs.

PART 3 - EXECUTION

INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

Provide weatherproof boxes and fittings for interior and exterior locations that are exposed to weather or moisture. Weatherproof boxes must be Listed and Labeled and identified as "extra duty" for use in wet locations.

Provide knockout closures to cap unused knockout holes where blanks have been removed.

Install electrical boxes and similar items only in those locations that ensure accessibility to enclosed electrical wiring.

Avoid installing boxes back-to-back in walls. Provide not less than 6" separation in non-rated partitions. Provide 24" minimum horizontal separation in fire-rated partitions or in acoustic rated walls.

Position recessed outlet or device boxes in walls or ceilings accurately to allow for surface finish thickness. Where the surface material or covering is combustible the front edge of the plaster ring (or box) shall be flush (- 0",+1/32") with the finished surface. Where the wall or ceiling material is non-combustible, the front edge of the plaster ring (or box) may be recessed into the wall no further than 3/16". The maximum gap between the edge of an installed box/plaster ring combination shall not exceed 1/8". **These requirements will be rigidly enforced.**

Set floor boxes so that top edge of the box is level (± 5°) with finish flooring material. Install cover plates so that plate is flush (- 1/32",+ 0") with the finished floor level. **These requirements will be rigidly enforced**.
Do not use round boxes unless noted otherwise on the Drawings.

Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. All boxes shall be supported independently of conduit.

Provide electrical connections for installed boxes.

Electrical box locations indicated on Drawings are approximate unless dimensioned. Verify location of outlets prior to rough-in. Coordinate exact locations with the work of other Divisions. Mis-located outlets and/or devices shall be relocated upon instruction from Owner's representative at no additional cost.

Locate and install to maintain headroom and to present a neat appearance.

Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems. Provide barriers to separate adjacent devices where the voltage is greater than 150 Volts between the devices.

Install boxes in walls without damaging wall insulation or fire proofing.

Position outlets to locate lighting fixtures and/or luminaries as indicated on Drawings. Boxes are to be positioned plum and vertical, ± 2°.

Align wall mounted outlet boxes for switches, thermostats, and similar devices.

Subsequent to installation of boxes, protect boxes from construction debris and damage.

GROUNDING

Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION 260535

SECTION 260579 - TEMPORARY POWER AND LIGHTING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Manufacturer's Data: Submit manufacturer's technical product data.

SCOPE OF WORK

Provide complete jobsite temporary electrical power service equipment, distribution panels, distribution wiring, luminaries, and connection devices as described in this section of the project specifications.

Cost of electrical energy for the duration of the project shall be the responsibility of the General Contractor.

PART 2 - PRODUCTS

Products shall be new and as specified in this Division unless reuse of existing facilities is specifically indicated on the Drawings.

PART 3 - EXECUTION

Provide temporary electrical service and service equipment required for construction activities of all project divisions. Provide connection of the electrical service to the electrical utility. All fees and permits for the temporary electrical service are the responsibility of the Contractor.

Provide Temporary Lighting: Provide temporary lighting for general illumination and task illumination for the General Contractor, other prime contractors, and for all sub-contractors for the duration of the construction. Lighting levels provided are to be in compliance with applicable workplace standards.

> Complaints concerning lighting levels and/or lighting quality in a specific area or areas of the project will be reviewed by the A-E. If directed by the A-E, the Contractor shall provide additional luminaries and/or additional distribution wiring required under this section at no additional cost.

All temporary lighting shall be supplied by circuits protected by ground fault circuit breakers. All temporary lighting shall be in accordance with NFPA-70 Article 590.

Provide Temporary Power Distribution: Provide temporary power distribution and connection devices for use by General Contractor, other prime contractors, and for all sub-contractors for the duration of the construction. Provide temporary power distribution and connection devices for the testing of selected items of utilization equipment as required by General Contractor, other prime contractors, or any sub-contractor.

Complaints concerning power distribution or devices available in a specific area or areas of the project will be reviewed by the A-E. If directed by the A-E, the Contractor shall provide additional power distribution or connection devices required under this section at no additional cost.

All temporary branch circuits shall be supplied by circuits protected by ground fault circuit breakers. All temporary branch circuits shall be in accordance with NFPA-70 Article 590.

Remove all Temporary Wiring: At the conclusion of construction activities remove all wiring, both exposed and concealed, used for temporary lighting and power distribution.

END OF SECTION 260579

SECTION 260590 - PAINTING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturer: Subject to compliance with requirements, provide products of one of the following:

Sherwin-Williams
PPG Industries, Pittsburgh Paints (PPG)
Benjamin Moore
Glidden

Material Quality: Provide the manufacturer's best-quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Manufacturer's Data: Submit manufacturer's technical product data for each paint system specified, including block fillers and primers.

Provide the manufacturer's technical information including label analysis and instructions for handling, storage, and application of each material proposed for use.

Identify each material by the manufacturer's catalog number and general classification.

Samples for initial color selection in the form of manufacturer's color charts.

Certification by the manufacturer that products supplied comply with local regulations controlling use of Volatile Organic Compounds (VOCs).

SCOPE OF WORK

Paint raceway, fittings, boxes, non-decorative box covers, cabinets, and similar items that are furnished under Divisions 26-28.

Paint exposed surfaces, whether or not colors are designated in the schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish of adjacent surface is not designated, the Architect will select from standard colors or finishes available.

Painting of Division 26-28 items in electrical rooms, mechanical rooms, attics, basements, and similar non-public spaces is not required.

Painting is not required on pre-finished items, stainless steel metal surfaces, concealed surfaces, operating parts, and labels.

Labels: Do not paint over Underwriters Laboratories, Factory Mutual, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

PART 2 - PRODUCTS

Colors: Match colors indicated by reference to the manufacturer's standard color designations.

Paint Materials, General: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer, based on testing and field experience.

Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

PART 3 - EXECUTION

Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.

Delivery and Storage of Materials: Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the product trade name manufacturer's instructions.

Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45° F. (7° C.). Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

Project Conditions: Do not apply paint in snow, rain, fog, or mist, or when the relative humidity exceeds 85 percent, or at temperatures less than 5° F. (3° C.) above the dew point, or to damp or wet surfaces.

Apply waster-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50° F. (10° C.) and 90° F. (32° C.).

Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45° F. (7° C.) and 95° F. (35° C.).

Examine substrates and conditions under which painting will be performed for compliance with requirements. Do not begin application until unsatisfactory conditions have been corrected.

Preparation: Remove finished hardware and hardware accessories, plates, machined surfaces, and similar items already installed that are not to be painted, or provide appropriate masking and/or protection prior to surface preparation and painting. Following completion of painting operations in each space or area, remove masking and have items reinstalled by skilled workers.

Cleaning: Clean substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

Surface Preparation: Clean and prepare surfaces to be painted according to the manufacturer's instructions for each particular substrate condition and as specified.

Provide barrier coats over incompatible primers or remove and re-prime.

Prime Coats: Before applying finish coats, apply a prime coat to material to be painted or finished that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
Ferrous Metals: Clean un-galvanized ferrous-metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents and touch up with the same primer as the shop coat.

Galvanized Surfaces: Clean galvanized surfaces with non-petroleum based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

For galvanized surfaces use only primer and/or paint systems specifically labeled as appropriate for use on galvanized surfaces.

Materials Preparation: Carefully mix and prepare paint materials according to manufacturer's directions.

Use only thinners approved by the paint manufacturer and only within recommended limits.

Application: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

Paint colors, surface treatments, and finishes are indicated to match the color of surrounding surfaces.

The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until previous coat has cured. Sand between applications where sanding is required to produce an even smooth surface.

Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance.

The term exposed surfaces includes areas visible when permanent or built-in fixtures are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.

Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.

Paint back sides of box covers, access panels, and removable or hinged covers to match exposed surfaces.

Application Procedures: Apply paints and coatings by brush or other applicators according to manufacturer's directions.

Minimum Coating Thickness: Apply materials at the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with specified requirements.

Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

Protect work of other trades, whether being painted or not, against damage by painting or painting activities.

After completing painting, clean surrounding paint-spattered surfaces as required to leave such areas clean and free of blemish.

Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 260590

SECTION 260593 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, solder/fluxes, and cable ties, whose products are Listed.

Codes and Standards:

NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

Testing Laboratory Compliance: Comply with UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials that are Listed and Labeled.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on electrical connections for equipment products and materials.

PART 2 - PRODUCTS

MATERIALS AND COMPONENTS

General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

Metal Conduit, Tubing and Fittings:

General: Provide metal conduit, tubing and fittings of types, grades, and sizes indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Section 260534, *RACEWAYS*, and in accordance with the following listing of metal conduit, tubing and fittings:

Rigid steel conduit

Rigid metal conduit fittings

Electrical metallic tubing

EMT fittings

Flexible metal conduit

Flexible metal conduit fittings

Liquid-tight flexible metal conduit

Liquid-tight flexible metal conduit fittings

Wires, Cables, and Connectors:

General: Provide wires, cables, and connectors complying with Section 260519, *SECONDARY VOLTAGE WIRES AND CABLES*.

Wires/Cables: Unless otherwise indicated, provide conductors for electrical connections that match, including sizes and ratings, of wires/cables that are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 68° F.

Connectors and Terminals: Provide copper electrical connectors and terminals that mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications. **Aluminum conducting components are not acceptable for use on this project.**

Electrical Connection Accessories: Provide electrical insulating tape, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

INSPECTION

Inspect area and conditions under which electrical connections for equipment are to be installed and notify A-E in writing of conditions detrimental to proper completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

INSTALLATION OF ELECTRICAL CONNECTIONS

Install electrical connections as indicated in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA'S "Standard of Installation" to ensure that products fulfill requirements.

Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating than electrical insulation rating of those conductors being spliced.

Prepare cables and wires by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes that will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance. Leave a minimum of 6” of excess spare conductor at each termination.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torque requirements are not available, tighten connectors and terminals to comply with torque values contained in UL 486A.

Provide flexible connections to equipment as follows:

Provide Flexible Metal Conduit (FMC) for connection of electrical equipment where subject to movement and vibration or as otherwise required by the Specifications or on the Drawings.

Provide metal Liquidtight Flexible Metal Conduit (LFMC) for equipment in exterior locations, wet locations, or in other locations where so indicated on the Drawings.

Fasten identification markers to each electrical power supply wire/cable conductor that indicates their voltage, phase and feeder number in accordance with Section 260533, *ELECTRICAL IDENTIFICATION*. Affix markers on each terminal conductor, as close as possible to the point of connection.

FIELD QUALITY CONTROL

Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 260593

SECTION 260800 - TESTING AND PLACING IN SERVICE

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of contract, including general and supplementary conditions and Division-1 Specification Sections, apply to work of this Section.

WORK INCLUDED

Provide all material, equipment, labor and technical supervision to perform and complete the electrical acceptance tests in accordance with the requirements of this section for equipment installed as the Work of this contract. Notify A-E at least four (4) working days in advance of tests.

Perform Tests on the Following Equipment and/or in the following areas:

- Busways
- Cable Tests
  - Low Voltage (≤ 600 Volt)
- Grounding
- Ground fault operation and coordination
- Metering
- Overcurrent devices
- Service Equipment Tests
- Switchboards and Panelboards (≤ 600 Volt)

DEFINITIONS

Measure: To obtain the requested system information by use of suitable instruments and to record this information in the appropriate section of the test report.

Repaired: Material or equipment that has been brought to new condition, retested, and made to pass all required tests.

QUALITY ASSURANCE

Perform tests to obtain required information in accordance with accepted industry procedures and/or in accordance with manufacturer's recommendations. Should manufacturer's recommendations conflict with these specifications, notify A-E. Do not proceed with tests until directed by A-E.

Material or equipment failing tests shall be repaired or replaced at the Contractor's expense.

The Contractor shall be responsible for all tests and for documentation of test data. Testing shall be performed by or under the immediate supervision of the Contractor.

DOCUMENTATION

Records of all tests and inspections, with complete data on all readings taken, shall be made and incorporated into a single report.

Five (5) bound copies of all test reports shall be submitted at the end of the test period. All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the prerequisites for, final acceptance of the project.

PART 2 - PRODUCTS

The Contractor shall employ testing devices as required to accomplish specified testing herein and as described elsewhere in the Contract Documents.

Test Equipment Suitability: The test equipment used by the Contractor shall be suitable for the intended tests and shall comply with ANSI/NETA ATS-2009, Section 5.2.

Test Equipment Calibration: The test equipment used by the Contractor shall be suitable for the intended tests and shall comply with ANSI/NETA ATS-2009, Section 5.3.

PART 3 - EXECUTION

GENERAL

Check cable continuity and phase identification for each conductor used on the project. This includes service conductors, feeders, and branch circuit conductors. It is not required to document this test in the testing report required under this section.

Insulation testing: The insulation tests (megger tests) as specified in this Section are the minimum readings desired at an ambient temperature of 60° F and a low relative humidity.

Megger readings taken at other than ambient temperature of 60° F shall be corrected to 60° F.

When megger readings fall below the specified minimum values utilize recognized means to dry out the equipment. The method utilized by the Contractor must be in accordance with manufacturer's written instructions.

If drying is to be accomplished by applying an electric potential to a cable or piece of equipment, then, in no case (induced or direct) shall the voltage or current exceed the ampacity or the continuous rating of the equipment being dried.

CABLE TESTS

General: Disconnect each end of all cables from their associated equipment prior to the test.

Cables ≤ 600 Volt: Inspect all cable connections for workmanship and conformance with standard practice.

Perform the following tests:

Test cable insulation using a megger.

Perform megger tests between phases and between each conductor and ground with the other conductors and interlocked armor (if part of cable assembly) grounded.

Test other conductors in the same manner. The minimum acceptable megger reading for cables shall be 1 megohm (MΩ) for #6 AWG conductors and smaller and 250,000 ohms (Ω) for #4 AWG conductors and larger.

The Test Record Shall Include the Following:

Complete identification of the cable, including approximate length.

Megger reading data.

GROUNDING

Resistance: Measure the resistance (relative to earth) of each electrical equipment ground brought up from each grounding electrode, made electrode (rod), and the underground grid.

Do not measure outside ground rod and ground grid resistances to earth during unusually wet weather.

The Test Record Shall Include the Following:

Identification of the ground point where the test is performed.

Value of resistances relative to earth.

Test ground resistance with tester equivalent to Fluke 1625. Test arrangement shall be based on a three point, fall of potential test. Two field installed stakes used for the test shall be placed to form a line with the driven grounding electrode and separated at intervals of 60 feet. Where tests show resistance-to-ground is over 25 Ohms, take appropriate action to reduce resistance to 25 Ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

GROUND FAULT OPERATION AND COORDINATION

Upon selection of the product line and approval of the equipment submittal package, the engineer shall conduct a coordination study to determine appropriate settings for adjustable circuit breakers. The ground fault protection on the circuit breakers shall be set in accordance with information provided by the engineer.

Performance Testing of Time-Current Functions: For services 1,000 amperes and larger, the following tests should be performed on the service circuit breakers and the distribution circuit breakers. Using circuit breaker test set, set and field test time-current trip functions for new circuit breakers to verify operation in accordance with the circuit breaker settings provided by the engineer. Testing shall be performed by a qualified factory technician at the job site. All readings shall be tabulated:

Ground fault tripping tolerance (within 20% of UL requirements).

Trip time in seconds.

Where additional testing of existing equipment is indicated on the drawings, use circuit breaker test set to set and field test time-current trip functions for existing circuit breakers to verify operation in accordance with the circuit breaker settings provided by the engineer.

METERING

General: Test all meter functions to verify the accuracy of the readings for each meter and display instrument provided as a part of the project. Where meters are provided with selector switches, all functions shall be tested for each switch position and/or for each combination of switch positions.
The Test Record Shall Include the Following:

Complete identification of the meter and, as appropriate, switch function selected.

Meter reading as compared with the reading of the test instrument. For meters that display harmonic functions provide the displayed values for each harmonic.

OVERCURRENT DEVICES

Upon selection of the product line and approval of the equipment submittal package, the engineer shall conduct a coordination study to determine appropriate settings for adjustable circuit breakers. The time-current protection on adjustable circuit breakers shall be set in accordance with information provided by the engineer.

Performance Testing of Time-Current Functions: For services 1,000 amperes and larger, the following tests should be performed on the service circuit breakers and the distribution circuit breakers. Using circuit breaker test set, set and field test time-current trip functions for new circuit breakers to verify operation in accordance with the circuit breaker settings provided by the engineer. Testing shall be performed by a qualified factory technician at the job site. All readings shall be tabulated:

Phase tripping tolerance (within 20% of UL requirements).

Trip time (per phase) in seconds.

Instantaneous trip (amps) per phase.

Insulation resistance (in megohms) at 1,000 volts (phase to phase, and line to load).

Where additional testing of existing equipment is indicated on the drawings, use circuit breaker test set to set and field test time-current trip functions for existing circuit breakers to verify operation in accordance with the circuit breaker settings provided by the engineer.

Operational Test Procedures for Circuit Breakers: Visually inspect and manually operate breakers through a minimum of three (3) open/close cycles. Check for correct alignment, freedom from binding and good contact. Check phase matching and phase rotation immediately prior to energizing of equipment.

SERVICE EQUIPMENT TESTS

Voltage Tests: Measure the no-load and full-load voltages (phase-to-phase and phase-to-ground for each phase) of each service and for each separately derived system.

Load Tests: Measure the load on each phase of the main service and each phase of every feeder under maximum load conditions.

The Test Record Shall Include the Following:

Complete identification of each test location.

Values of no-load and full-load voltage.

Values of no-load and full-load current.

SWITCHBOARDS AND PANELBOARDS (≤ 600 VOLT)

Prior to testing, inspect all compartments and apparatus.

With all breakers, fused switches, starters, and contactors in the open position and cables connected, test the bus insulation for each phase with a megger. The minimum acceptable megger reading shall be 100 megohms (MΩ).

Manually and automatically, as applicable, operate all breakers, switches, contactors, relays, motor starters and the like to ascertain that correct and positive operation, interlocking and alarm have been achieved.

After all fixtures, devices and equipment are installed and all connections completed to each panel, the Contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 Ohms, the Contractor shall disconnect and test each branch circuit neutral wire to the grounded enclosure to isolate the low readings. The Contractor shall correct troubles, reconnect and retest until a minimum resistance of 250,000 Ohms exists between the neutral bar and ground with only the feeder neutral disconnected.

The Test Record Shall Include the Following:

Complete identification of panelboard.

Resistance of each phase bus relative to ground

Resistance between neutral bus and ground bus with neutral lifted.

Specified Megger and High Potential Tests Shall Be As Follows:

EQUIPMENT	MEGGER VOLTAGE	MIN. MEGGER READING (megohms)
4160 Volt bus	2500	800
480 Volt bus	500	10
480 Volt breaker	500	100
208 Volt breaker	500	100
Current Transformer secondary wiring	500	5

In accordance with manufacturer's recommendations, maintain 2500-Volt and 500-Volt megger tests until the reading reaches a constant value and until three (3) consecutive equal readings one (1) minute apart are obtained. Maintain all 2500-Volt megger tests at least five (5) minutes and until three (3) consecutive readings one (1) minutes apart are obtained. Take readings every 30 seconds during the first two (2) minutes and every minute thereafter. Record all megger readings.

Acceptance: Make complete and accurate records of all tests. All megger readings shall pass manufacturer's specified and minimum values. Equipment shall pass operational tests and visual inspection requirements.

The Test Record Shall Include the Following:

Complete identification of all test points, including a description of which terminals are shorted and/or grounded.

Megger readings versus time data.

The approximate average equipment temperature.

DOCUMENTATION

All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.

All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the prerequisites for, final acceptance of the project.

TEST RESULTS

The Contractor shall send a letter to the engineer, with a copy to the State Construction Office (SCO) official project observer, certifying that the above testing has been performed. This shall be done at least four (4) days prior to final inspection.

Final testing reports are to be available at the SCO final inspection.

At final inspection, the Contractor shall furnish instruments as required to demonstrate to the A-E and to the SCO representative that all testing requirements have been satisfied. All measurement instruments, labor, and materials associated with the testing, verification, and demonstration of results shall be provided without additional cost. The contractor shall provide ladders, hand tools, digital multimeters, meggers, two-way radios, and other specific items required by the Engineer for the final inspection.

END OF SECTION 260800

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of panelboards, of types and ratings required in this Section, whose products are Listed and Labeled for the purpose intended. Subject to compliance with requirements provide equipment equivalent to that provided by one of the following manufacturers:

Square-D Company
Cutler Hammer
General Electric

Codes and Standards:

Electrical Code Compliance: Comply with applicable State code requirements of the authority having jurisdiction and NEC Article 408 as applicable to installation and construction of electrical panelboards and enclosures.

Testing Laboratory Compliance: Comply with applicable requirements of Std. No. 67, "Electric Panelboards," and Stds No.'s 50, 869, 486A, 486B, 489, and 1053 pertaining to panelboards, circuit breakers, accessories and enclosures. Provide units that are Listed and Labeled.

Special-Use Markings: Provide panelboards, constructed for special-use, with appropriate Listed marks that indicates that they are suitable for special type of use/application including service entrance equipment.

NEMA Compliance: Comply with NEMA Stds. Pub./No. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 01 99 13. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on panelboards and enclosures.

Submit Time-Current Timing Charts: Provide response curves for all overcurrent protection devices furnished as a part of the project. Provide specific circuit breaker and trip unit model numbers for all specified electronic trip breakers, with available settings for engineer’s use in developing system coordination.

PART 2 - PRODUCTS

PANELBOARDS:

General: Except as otherwise indicated, provide panelboards, bolt-on breakers, integral common trip, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials. Panelboards shall be designed and constructed in accordance with published product information. Equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

Branch Circuit Panelboards: Provide factory assembled, dead front safety constructed, branch circuit panelboards of the circuit breaker type, in sizes and ratings indicated. Provide panelboard switching and protective devices in quantities, ratings, types, characteristics and with arrangement indicated. Panelboards shall be equipped with anti-turn solderless pressure type main lug connections approved for use with copper conductors. Construct panelboards with rectangular shaped bus bars of solid copper, with conductivity not less than 98%, which are securely mounted and braced, and with solderless lugs bolted to main bus bars. Panelboards specified with dual lugs for sub-feed shall include dual lugs for each phase at the point of termination. Feed-through bus arrangements are not acceptable.

Panelboards shall have full sized neutral bus and bare un-insulated ground bus suitable for bolting to enclosures. Panelboards shall have voltage ratings suitable for service voltage at which they will be used. Provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide molded case main and branch circuit bolt-on breaker types for each circuit, with toggle handles that indicate when tripped. Branch circuit breakers for switching lighting circuits shall be Type “SWD”; those used for switching high intensity discharge lighting circuits, Type “HID”.

Provide branch circuit panelboards with a maximum forty-two (42) branch circuit breaker positions. Where multiple pole breakers are indicated, they shall be provided with integral common trip so that overload on one pole will trip all poles simultaneously. Select enclosures, as noted on Drawings, fabricated by same manufacturer as panelboards and which mate and match properly with panelboards.

Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with no knockouts and code sized wiring gutters. Design enclosures for recessed or surface mounting as indicated on Drawings. Provide enclosures that are fabricated by same manufacturer as panelboard and which mate properly with panelboards to be enclosed.

Panelboard Fronts: Provide panelboard fronts with adjustable trim clamps, and doors with flush locks and keys. All locks for panelboard enclosures shall be keyed alike. Panelboard fronts shall be constructed with concealed piano door hinges and provided with baked gray enamel finish over a rust inhibitor coating. Panel doors are left hand doors unless otherwise indicated on the Drawings. Panelboard front shall be secured to the enclosure by the use of screws.

Provided hinged-type access for all panelboard doors so that access to the interior of the panelboard can be gained without the necessity of physically removing the panelboard cover.

Equip panelboard fronts with interior circuit directory frame, and card with clear plastic covering. Information from panel schedules shall be typed on the directory card. Hand lettering of directory cards is not acceptable.

Molded Case Circuit Breakers: Provide factory assembled, molded case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault current limiting protection, ampere ratings as indicated. Construct with overcenter, trip free, toggle type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position in an ambient temperature of 40^{o}C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

Circuit Breaker Lugs: Provide circuit breaker lugs to match feeder conductors or branch circuit conductors as indicated on the Drawings. In general, the ampere rating of circuit breakers is selected to support the requirements of the load. In cases where circuit conductor size has been increased for improved voltage drop, or other reasons, provide increased lug size as needed to match increased conductor size. Provide larger circuit breaker frame size if same is required to accommodate increased conductor size as described above.

Fully Rated Circuit Breakers: Series rated circuit breakers are not permitted. Provide fully rated circuit breakers unless specifically indicated otherwise on the Drawings.

Special Purpose Circuit Breakers: Where indicated, provide circuit breakers with the following additional features:

1. Ground-Fault Circuit Interrupter (GFCI), UL 943, single-and two-pole configurations with 5-mA trip sensitivity with Ampere rating as indicated on panelboard schedule. Breaker shall also be listed to UL 489 for molded case circuit breakers.

2. Arc-Fault Circuit Interrupter (AFCI), UL 1699, for protection of branch circuit wiring, rated 20 Amps as indicated on panel schedule. Breaker shall also be listed to UL489 for molded case circuit breakers.

Circuit Breaker Positions: Circuit breaker positions are indicated on panel schedules in the Drawings. Indicated positions are mandatory unless changes are specifically approved in writing by the A-E.

Panelboard submittals shall not be used as a means of obtaining approval for alternate circuit breaker positions.

Panelboard Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, cartridge and plug time-delay type fuses, circuit-breakers, ground-fault protection units, lugs, grounding terminations, labels, etc., as recommended by panelboard manufacturer for ratings and as indicated on the Drawings.

Short Circuit Rating: Unless otherwise indicated, panelboards and all devices shall have a minimum short circuit withstand rating of 10,000 RMS symmetrical Amperes.

PART 3 - EXECUTION

EXAMINATION

Examine areas and conditions under which panelboards and enclosures are to be installed and notify A-E in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

INSTALLATION OF PANELBOARDS

General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standard of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.

Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

Provide properly wired electrical connections for panelboards within enclosures.

Fill out panelboard's circuit directory card with typewriter upon completion of installation work. Circuit descriptions shall match those on the panel schedule in the Drawings.

Equipment/System Identification: Provide equipment identification nameplates complying with Section 26 05 33, *ELECTRICAL IDENTIFICATION*.

GROUNDING

Provide equipment grounding connections for panelboards as indicated. Tighten connections to comply with tightening torques specified in UL Stds 486A to assure permanent and effective grounds. All panelboards shall be grounded with an insulated grounding conductor routed with the panel feeder. The grounding conductor shall be bonded to the panel grounding bus and a bonding bushing on the panelboard feeder raceway.

FIELD QUALITY CONTROL

Prior to energizing electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

Prior to energizing panelboards, check with resistance tester phase-to-phase and phase-to-ground insulation combinations to ensure insulation and continuity requirements are fulfilled.

Prior to energizing, check panelboards for electrical continuity of circuits, and for short-circuits.

ADJUSTING AND CLEANING

Adjust operating mechanisms for free mechanical movement.

Touch-up scratched or marred surfaces to match original finishes.

DEMONSTRATION

Subsequent to wire and cable hookups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of wiring devices, of types and ratings required in this Section, whose products are Listed and Labeled for the purpose intended. Subject to compliance with requirements provide devices equivalent to that provided by one of the following manufacturers:

Hubbell
Cooper Devices
Leviton
Pass & Seymour

Codes and Standards:

NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.

Testing Laboratory Compliance: Comply with applicable requirements of UL 20, 486A, 498, and 943 pertaining to installation of wiring devices. Provide wiring devices that are Listed and Labeled.

NEMA Compliance: Comply with applicable portions of NEMA Standards No. WD 1, "*General Purpose Wiring Devices*", WD 2, "*Semiconductor Dimmers for Incandescent Lamps*", and WD 5, "*Specific Purpose Wiring Devices*".

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 01 99 13. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on electrical wiring devices.

PART 2 - PRODUCTS

FABRICATED WIRING DEVICES

General: Provide factory fabricated wiring devices in types, colors, and electrical ratings for applications indicated and which comply with NEMA WD 1.

"Specification" grade devices, as used in this section shall be "Industrial Specification" or "Heavy Duty" grade devices. "Commercial Specification" grade devices shall not be considered equivalent and are not acceptable.

Color: Provide white color devices unless indicated otherwise for selected locations elsewhere in the Specifications or on the Drawings.

Provide red face devices in all cases where receptacles are supplied from a generator derived power source.

Receptacles:

General-Use Duplex: Provide duplex specification grade type receptacle, 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, high impact nylon face, ground terminal, brass triple wipe contacts, 20A rated, 125-volts, with metal plaster ears. Provide receptacles with grounding terminal internally connected to mounting yoke. Receptacles shall be designed for side and back wiring with spring-loaded, screw activated pressure plates, with NEMA configuration 5-20R unless otherwise indicated.

General-Use Simplex: Provide single specification grade type receptacle, 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, high impact nylon face, ground terminal, brass triple wipe contacts, 20A rated, 125 volts, with metal plaster ears. Provide receptacles with grounding terminal internally connected to mounting yoke. Receptacles shall be designed for side and back wiring with spring-loaded, screw activated pressure plates, with NEMA configuration 5-20R unless otherwise indicated.

Ground-Fault Interrupter: Provide specification grade ground-fault circuit interrupter, with heavy-duty duplex receptacles capable of being installed in a 1-1/2" deep outlet box without adapter. Ground fault interrupter receptacles shall be grounding type, UL Class A, Group 1, 20A rated, 120-volts, 60 Hz, with high impact nylon face, brass triple wipe contacts, and solid-state ground-fault sensing and signaling. Devices shall have 5mA ground-fault trip level and shall be equipped with NEMA configuration 5-20R.

Special Receptacles: Provide special receptacles with NEMA configuration, voltage rating, current rating, and other attributes as indicated on the Drawings in Receptacle Schedules, General Notes, Keyed Notes, or other designations.

Receptacles provided are to be either straight blade, locking type, or pin type as indicated. All receptacles are to be equipped with green hexagonal equipment ground screw, brass triple wipe contacts and brass connector screws.

Miscellaneous Features:

Provide the following additional receptacle features where such is required by code or indicated on the drawings:

Weather resistant (WR) for all general use and ground fault interrupter receptacles installed in damp and wet locations.

Duplex receptacles with two vertical USB ports. Ports shall provide 3.0 minimum amps charging capacity and include LED indicator light to indicate presence of USB power (5 VDC). Ports shall be compatible with USB 2.0 and 3.0 devices

Switches:

Snap: Provide heavy-duty, specification grade, flush single-pole AC quiet toggle switches, 20 Amperes, 120-277 Volts AC, with silver cadmium oxide contacts, brass terminal screws, and mounting yoke insulated from mechanism. Equip switches with plaster ears, switch handle, and green hexagonal equipment grounding screw. Switches shall be designed for side and back wiring with spring-loaded, screw activated pressure plates.

Duplex Snap: Provide heavy duty, specification grade, flush dual single pole AC quiet switches, 20 Amperes, 120-277 Volts, with silver cadmium oxide contacts, brass terminal screws, and mounting yoke insulated from mechanism. Equip switches with plaster ears, switch handles, green hexagonal equipment grounding screw and side wired screw terminals with break-off tab feature that allows wiring with separate or common feed.

Two Pole Snap: Provide heavy duty, specification grade, flush two pole AC quiet switches, 20 Amperes, 120-277 Volts, with silver cadmium oxide contacts, brass terminal screws, and mounting yoke insulated from mechanism. Equip switches with plaster ears, switch handle, green hexagonal equipment grounding screw and side wired screw terminals.

Three Way: Provide heavy-duty, specification grade, flush 3-way AC quiet switches, 20A, 120-277 Volts, with silver cadmium oxide contacts, brass terminal screws, and mounting yoke insulated from mechanism. Equip switches with plaster ears, switch handle, green hexagonal equipment grounding screw. Switches shall be designed for side and back wiring with spring-loaded, screw activated pressure plates.

Four Way: Provide heavy-duty, specification grade, flush 4-way AC quiet switches, 20A, 120-277 Volts, with silver cadmium oxide contacts, brass terminal screws, and mounting yoke insulated from mechanism. Equip switches with plaster ears, switch handle, green hexagonal equipment grounding screw. Switches shall be designed for side and back wiring with spring-loaded, screw activated pressure plates.

Lighted Handle Snap: Provide heavy duty, specification grade, flush single pole AC quiet lighted handle toggle switches with silver cadmium oxide contacts and brass terminal screws in any of the pole configurations indicated above. Switches shall be equipped with plaster ears, have side wired screw terminals, and a 20A, 120-277 Volts rating. Lighted handle shall be illuminated when the switch is in the open position.

Pilot Light Handle Snap: Provide heavy duty, specification grade, flush single pole AC quiet pilot light handle toggle switches with silver cadmium oxide contacts and brass terminal screws in any of the pole configurations indicated above. Switches shall be equipped with plaster ears, have side wired screw terminals, and a 20A, 120-277 Volts rating. Lighted handle shall be illuminated when the switch is in the closed position.

Miscellaneous Features:

Provide the following additional switch features where such is indicated on the drawings:

Key operation; supply one key per switch.

0-10 Volt Dimmers: Provide specification grade, preset type slide control, single pole branch lighting solid state 0-10 Volt DC dimmer control for LED source fixtures. Dimmers shall be designed for side and back wiring with spring-loaded, screw activated pressure plates where such are available. Wattage shall be a minimum of 125% of the connected load unless otherwise specified on the Drawings. Dimmer shall be compatible with fixture driver/ballast in coordination with light fixture package provided.

WIRING DEVICE ACCESSORIES

Wall Plates for Flush Mounted Devices: Provide standard sized stainless steel (Type 302) wall plates for flush mounted single and combination wiring devices of types, sizes, and with ganging and cutouts as required for the application. Select plates that mate and match wiring devices to which attached; provide blank plates for empty or unused boxes. Provide screws for securing plates to devices; screw heads shall match finish of plates. Oversized plate shall not be used unless specifically permitted by the A-E. A quantity of 2% spare plates shall be provided for the Owner.

Wallplates for Surface Mounted Devices: Provide steel plates as required to match device box construction.

Wallplates for exterior and/or wet locations: Provide weatherproof PVC products listed as "extra duty while in use." Covers shall be rectangular, transparent high-impact, UV-resistant polycarbonate.

PART 3 - EXECUTION

INSTALLATION OF WIRING DEVICES

Install wiring devices as indicated in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

Install wiring devices only in electrical boxes that are clean, free from excess building materials, dirt, and debris.

Install wiring devices after wiring work is completed.

Install wallplates after painting work is completed.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torque's specified in UL Stds 486A and B. Use properly scaled torque indicating hand tool.

PROTECTION OF WALLPLATES AND RECEPTACLES

Upon installation of wallplates and receptacles, advise other project Contractors regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items that have been damaged, including those burned and scored by faulty plugs.

GROUNDING

Provide equipment grounding connections for all wiring devices, unless otherwise indicated. All devices, including switches, shall be grounded by an individual insulated green equipment grounding conductor connected to the grounding conductor that is run with the ungrounded conductors, and attached to the device box. Comply with tightening torque's specified in UL Std. 486A to assure permanent and effective grounds.

TESTING

Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices to demonstrate compliance with requirements.

FIELD QUALITY CONTROL

Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Correct any faults to assure compliance with requirements. Retest to demonstrate compliance. Devices that fail to comply with requirements shall be removed and replaced with new units. Retest all replaced devices.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work of this section.

QUALITY ASSURANCE

Manufacturer's Qualifications: Firms regularly engaged in manufacture of fuses of types and sizes required, whose products are Listed and Labeled.

Codes and Standards:

Testing Laboratory Compliance: Comply with applicable provisions of UL 198D, "High-Interrupting-Capacity Class K Fuses." Provide overcurrent protective devices that are Listed and Labeled.

NEC Compliance: Comply with NEC as applicable to construction and installation of fuseable devices.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 01 99 13. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's technical product data on fuses, including specifications, electrical characteristics, installation instructions, furnished specialties and accessories. In addition, include voltages and current ratings, interrupting ratings, current limitation ratings, time-current trip characteristic curves, and mounting requirements. Time-current curves must be full size as provided by the fuse manufacturer and printed on vellum or mylar.

PART 2 - PRODUCTS

FUSES

General: Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time-current and peak let-through current characteristics indicated, which comply with manufacturer's standard design, materials, and constructed in accordance with published product information, and with industry standards and configurations.

Class RK1 Time-Delay Fuses: Provide UL Class RK1 time-delay fuses, 60 Hz, ampere and voltage rated as indicated on the Drawings with 200,000 Ampere RMS symmetrical interrupting current rating.

Class RK5 Time-Delay Fuses: Provide UL Class RK5 time-delay fuses, 60 Hz, ampere and voltage rated as indicated on the Drawings with 200,000 Ampere RMS symmetrical interrupting current rating for protecting motors.

Spare Fuses: Furnish ten (10%) percent spare fuses (or three {3}, whichever is greater) of each size and type installed in equipment, including integrally-fused MCCB's. This includes fuses for equipment furnished by others.

Fuse Cabinet: Furnish and install one (1) 30" x 24" x 12" surface-mounted, NEMA 1 storage cabinet with hinged door, locking handle and cylinder type lock and two (2) shelves. Spare fuses will be stored in this cabinet. Cabinet shall be as manufactured by Bussmann or engineer approved equivalent.

Applicable provisions of this section apply to switches and fused switches that are supplied as a part of panelboards or other equipment.

PART 3 - EXECUTION

EXAMINATION

Examine areas and conditions under which fuses are to be installed and notify A-E in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until satisfactory conditions have been corrected in a manner acceptable to A-E.

INSTALLATION OF FUSES

Where Fuses Are To Be Installed, Comply With the Following:

Install fuses as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC, and NEMA standards for installation of fuses.

Coordinate with other work, including electrical wiring, as necessary, to interface installation of fuses with other work.

Install fuses in fused safety switches.

FIELD QUALITY CONTROL

Prior to energization of fuseable devices, test devices for continuity of circuitry and for short-circuits. Replace malfunctioning units with new units, and then demonstrate compliance with requirements.

END OF SECTION 262813

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

SUMMARY

This section includes fusible switches, non-fusible switches, molded case circuit breakers and enclosures.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of electrical switches and circuit breakers, of types and ratings required in this Section, whose products are Listed and Labeled for the purpose intended. Subject to compliance with requirements provide equipment equivalent to that provided by one of the following manufacturers:

Square D
Cutler Hammer
General Electric

Codes and Standards:

NEC Compliance: Comply with NEC requirements pertaining to construction and installation of electrical switches and circuit breakers.

Testing Laboratory Compliance: Comply with applicable requirements of UL 489, “Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker enclosures pertaining to circuit breakers, accessories and enclosures. Provide units that are Listed and Labeled.

Special-Use Markings: Provide enclosed circuit breakers, constructed for special-use, with appropriate Listed marks that indicates that they are suitable for special type of use/application including service entrance equipment.

Testing Laboratory Compliance: Comply with requirements of UL 98, "*Enclosed and Dead-Front Switches*". Provide safety switches that have been Listed and Labeled.

NEMA Compliance: Comply with applicable requirements of NEMA Standard Publication No. KS 1, "*Enclosed Switches*" and 250, "*Enclosures for Electrical Equipment (1000 Volts Maximum)*."

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on electrical switches and circuit breakers.

Submit Time-Current Timing Charts: Provide response curves for all overcurrent protection devices furnished as a part of the project. Provide specific circuit breaker and trip unit model numbers for all specified electronic trip breakers, with available settings for engineer’s use in developing system coordination.

PART 2 - PRODUCTS

MOLDED CASE CIRCUIT BREAKERS

Thermal Magnetic Circuit Breakers: Provide factory assembled, molded case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault current limiting protection, ampere ratings as indicated. Construct with over-center, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position in an ambient temperature of 40ºC. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

Electronic Trip Circuit Breakers: Provide electronic trip units for breakers 400 Amps and larger, with field-replaceable rating plug and RMS sensing, responsive to current in each pole. Provide following field-adjustable settings:

1. Instantaneous trip.
2. Long-and short-time pickup levels.
3. Long-and short-time delay adjustments.

Provide ground fault pickup for breakers rated 1,000 Amps and larger, where unit serves as a main disconnecting means, as required under NEC.

1. Ground-fault pickup level, time delay, and I^2t response.

Energy Reduction Provisions: Provide breakers rated at 1,200 Amps and larger with maintenance switch and associated indicator light to permit the reduction of arc energy at and beyond the load side terminals for the breaker.

Circuit Breaker Lugs: Provide circuit breaker lugs to match feeder conductors as indicated on the Drawings. In general, the ampere rating of circuit breakers is selected to support the requirements of the load. In cases where circuit conductor size has been increased for improved voltage drop, or other reasons, provide increased lug size as needed to match increased conductor size. Provide larger circuit breaker frame size if same is required to accommodate increased conductor size as described above.

Special Purpose Circuit Breakers: Where indicated, provide circuit breakers with the following additional features:

1. Ground-Fault Circuit Interrupter (GFCI), UL 943, single-and two-pole configurations with 5-mA trip sensitivity with Ampere rating as indicated on the Drawings. Breaker shall also be listed to UL 489 for molded case circuit breakers.

2. Shunt Trip Provisions: Provide breakers with trip coil energized from separate circuit, with coil-clearing contacts.

Provide NEMA Type 1 enclosure unless otherwise indicated on the Drawings; provide NEMA Type 3R enclosure where the Drawings indicate weatherproof. Other enclosure types shall be furnished if specifically indicated on the Drawings.

FABRICATED SWITCHES

Safety Switches: Provide surface-mounted, heavy duty, steel enclosed safety switches, of types, voltage rating, current rating, and number of poles indicated on the Drawings.

Switches with no drawing indication of number of poles are three pole types. Switches shall be fusible type, rated as follows unless otherwise specified:

For 480Y/277 V.: Use 600 Volt type, with neutral and grounding bus.

For 208Y/120 V.: Use 250 Volt type, with neutral and grounding bus.

Provide internally mounted, insulated, neutral bus suitable for copper conductors. Provide separate equipment grounding bus, bonded to the enclosure and marked for use as a grounding bus.

Provide horsepower rated switches incorporating quick-make, quick-break type switches constructed so that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable. Internal current carrying components shall be high-conductivity copper; switch contacts shall be silver-tungsten type. Fuse holders shall have positive pressure type reinforced fuse clips. Where non-fused disconnect switches are indicated, provide solid copper bus bars in lieu of fuses.

Provide NEMA Type 1 enclosure unless otherwise indicated on the Drawings; provide NEMA Type 3R enclosure where the Drawings indicate weatherproof. Other enclosure types shall be furnished if specifically indicated on the Drawings.

Provide switches that may be locked in either the “ON’ or ‘OFF’ condition with a 1/4" shackle hasp-type lock. Safety switches shall have door interlocks that prevent the door from opening when the operating handle of the switch is in the “on” position. Manual defeat mechanisms shall be provided for the interlocks.

Provide two-pole interlock switches for all disconnects that are used with utilization equipment requiring control connections provided under other divisions. The interlock switch is to be configured such that when the disconnect is open the interlock switch is open.

Provide additional interlock switches, auxiliary contacts, mechanical key interlocks, or other accessories as may be described by the Drawings.

Fuses: Provide fuses for safety switches of classes, types, and ratings needed to fulfill electrical requirements of Divisions 26-28 supplied utilization equipment served by the safety switch. Dual element fuses shall be cartridge type with ferrule contact or knife-blade contact type as appropriate.

Fuses for equipment supplied by other divisions are to be furnished and installed by the division supplying the equipment.

Fuses are not to be installed by this contractor unless the equipment served by the disconnect is furnished under Divisions 26-28.

PART 3 - EXECUTION

INSTALLATION OF ENCLOSED SWITCHES AND CIRCUIT BREAKERS

Install electrical switches and circuit breakers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation," and in accordance with recognized industry practices.

Coordinate electrical switches and circuit breakers installation work with electrical raceway and cable work, as necessary for proper interface. Coordinate exact location of switches with equipment electrical connection point.

Locate electrical switches and circuit breakers so that they are accessible after all project elements are installed. Location selected for switches must permit complete opening of the disconnect door or cover to the maximum amount permitted by the design of the switch enclosure.

Install electrical switches and circuit breakers for use with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated.

Provide GFI circuit breakers with 30 mA sensitivity trip for all freeze protection, temperature maintenance, and heat tracing circuits.

GROUNDING

Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for electrical switches and circuit breakers. All electrical switches and circuit breakers shall be grounded by means of a separate insulated grounding conductor, run with the ungrounded conductors, and bonded to the disconnect enclosure by means of a dedicated grounding screw terminal or bus.

FIELD QUALITY CONTROL

Subsequent to completion of installation of electrical switches and circuit breakers, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.

END OF SECTION 262816

SECTION 263213 - DIESEL GENERATOR SET

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacturing of generators, of types and ratings required in this Section, whose products are Listed and Labeled for the purpose intended. Subject to compliance with requirements provide equipment equivalent to that provided by one of the following manufacturers:

Generac Power Systems
Caterpillar, Inc.
Cummins/Onan Corporation
Kohler

Agreement to Maintain: Engage installer who is willing to execute with the Owner, required agreement for continued maintenance of diesel engine driven generator units.

Codes and Standards:

Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 517, 700, 701, and 702 pertaining to construction and installation of emergency and standby systems as appropriate to the installation.

NFPA Compliance: Comply with applicable requirements of NFPA 30, *Flammable & Combustible Liquids Code*; NFPA 37, *Installation and Use of Stationary Combustion Engines and Gas Turbines;* NFPA 101, *Code for Safety to Life from Fire in Buildings and Structures*; and NFPA 110, Standard for Emergency and Standby Power Systems. The present system is considered to be a Level 1 Emergency Power Supply.

UL Compliance: Comply with applicable requirements of UL 1008, *Automatic Transfer Switches*; UL 486A, *Wire Connectors and Soldering Lugs for Use with Copper Conductors,* UL 486B, "*Wire Connectors for Use with Aluminum Conductors* and UL 2200*, Stationary Engine Generator Assemblies.*"

ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA MG 1, "*Motors and Generators*; and MG 2, *Safety and Use of Electric Motors and Generators*.

NEMA Compliance: Comply with applicable requirements of NEMA's Stds. Pub No. 250, *Enclosures for Electrical Equipment (1,000-Volts Maximum)*.

IEEE Compliance: Comply with applicable portions of IEEE Std. 446, *IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications*.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data on diesel engine driven generator sets and components. Include manufacturer's standard product warranty, for duration of not less than one-year, for replacement of materials and equipment used in diesel generator systems. As a minimum provide the following product information:

- Generator set physical and electrical specifications.

- Dimensional outline plan and elevations drawings of engine generator set, and other components being furnished.
- Thermal damage curve for generator
- Time-current characteristic curves for generator protective device.

Shop Drawings: Submit layout drawings of diesel engine driven generator units and accessories including, but not limited to, remote mounted automatic transfer switch, fuel line piping, exhaust line piping, remote start-stop stations, annunciator stations, and instrumentation. In addition, show the diesel generator set unit and its spatial relationship to associated equipment. Allow adequate clearance space for removal of engine generator elements for maintenance purposes.

Wiring Diagrams: Submit wiring diagrams for diesel engine driven generator units showing connections to electrical power panels, feeders, automatic transfer switches, annunciators, and ancillary equipment. Differentiate between portions of wiring that are manufacturer-installed and portions that are field installed.

Certifications: Provide diesel engine driven generator sets certified test record of the following final production testing:

Single-step load pickup
Transient and steady-state governing
Safety shutdown device testing
Voltage regulation
Rated power
Maximum power

Provide certified test record prior to engine-driven generator set being shipped from factory to project location.

Agreement to Maintain: Prior to time of final acceptance, the Contractor shall submit four (4) copies of an agreement for continued service and maintenance of diesel engine driven generator set, for Owner's acceptance. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, for one-year period with option for renewal of Agreement by Owner.

PART 2 - PRODUCTS

DIESEL GENERATOR SETS

General: Except as otherwise indicated, provide manufacturer's standard diesel engine-driven generator set and auxiliary equipment as indicated by published product information, and as required for a complete installation.

Diesel Engine-Driven Generator: Provide packaged electrical power diesel engine-driven generator assembly unit as indicated, rated **35**kW, 44kVA at 0.8 PF, at a governed speed of 1,800 RPM, and standby rated at 80 percent power factor for operation at 240 Volt, 1-phase, 3-wire, 60 Hz, 146 Amperes at 500 feet altitude, at 85° F. The alternator shall be 2/3 electrical pitch. Equip generator with 4-cycle, 6-cylinder, 56 HP diesel engine sized to support the generator load, and fueled with diesel fuel, Grade DF-2. Maximum piston speed shall not exceed 2,250 feet/minute. The generator prime mover shall be liquid cooled with a unit-mounted radiator, blower fan, water pump, thermostat, and radiator duct flange capable of cooling engine with up to 0.25 inches water static pressure on fan. Connect engine drive directly to revolving-field type single, maintenance-free, sealed bearing generator through semi-flexible steel disk coupling. Equip set with associated control equipment to automatically start engine, transfer load to standby power upon failure of normal power source, transfer load back to normal power upon its restoration, and stop engine.

Cushion-mount engine-generator on heavy steel base with vibration isolators to reduce possibility of torsional vibration. Equip engine with low-oil pressure, high-water temperature, and automatic overspeed safety shutdown devices. Equip generator with exciter and voltage regulator to maintain voltage within ½ percent of rated value from no load to full load. Construct unit in compliance with applicable standards; and with additional construction features as indicated.

Generator Set Indicating and Protective Devices and Controls: As a minimum provide an illuminated generator set mounted control panel with the following:

AC voltmeter.
AC ammeter.
AC frequency meter.
DC voltmeter (alternator battery charging).
Engine-coolant temperature gage.
Engine lubricating-oil pressure gage.
Running-time meter.
Ammeter-voltmeter, phase-selector switch(es).
Generator-voltage adjusting rheostat.
Off-Automatic-Run switch.
Overspeed shutdown device.
Coolant high-temperature shutdown device.
Coolant low-level shutdown device.
Oil low-pressure shutdown device.
Fuel tank derangement alarm.
Fuel tank high-level shutdown of fuel supply alarm.

Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.

Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Locate audible device and silencing means where indicated.

Generator Set Performance: The generator set shall meet the following minimum performance requirements. It shall be permissible to oversize the generator and/or engine from the above stated values to meet the requirements of this section.

Steady State Voltage Operational Bandwidth: within 2 percent band of rated output voltage from no load to full load.

Steady-State Voltage Modulation Frequency: Less than 1 Hz.

Transient Voltage Performance: Not more than 20 percent variation for 90 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 1.5 seconds.

Steady State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there are no random speed variations outside the steady-state operational band and no hunting or surging of speed.

Transient Frequency Performance: Less than 5 percent variation for a 90 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within five seconds.

Output Waveform: At no load and for any load up to rated load with power factors between 80 and 100 percent, Total Harmonic Distortion (THD) of the voltage waveform measured line to line or line to neutral shall not exceed 5 percent and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, the system will supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.

Excitation System: Generator automatic voltage regulation system shall use three-phase sensing to isolate regulator from voltage distortion caused by non-linear loads applied to the generator set. Regulator circuits shall be filtered to isolate field control power from effects of load distortion.

Maximum Start & Load Transfer Time: 10 Seconds.

Generator Disconnect: Provide circuit breaker main disconnect(s) for generator. The circuit breaker(s) shall have screw adjustments for timing function adjustment and shall be equipped with a sealable cover to prevent tampering.

Load Designation: 150 Amp, 240 Volt, 2 pole, 22,000 AIC, with full LSIG functions.

Ground Fault Sensor: The generator circuit breaker shall be equipped with an adjustable sensor, sized to match the circuit breaker size, to detect ground fault conditions. The sensor shall be field programmable to either trip the generator's disconnect circuit breaker or to close a set of dry contacts.

Ground Fault Remote Annunciator: Provide a remote annunciator for ground fault conditions. The alarm shall provide a visual and aural alarm in the event of a ground fault in excess of the setting of the ground fault sensor of the generator circuit breaker. Use of a spare light on the generator remote annunciator is acceptable provided that the light is labeled to match other labeling on the annunciator.

The circuit breaker, including neutral current transformer, shall be factory assembled to the generator. The circuit breaker with related components and enclosure shall be suitable for use in wet locations for outside generator sets.

Starting System: Provide engine-generator unit with 24-Volt, negative ground, starting system including 24-Volt positive engagement solenoid shift-starting motor, batteries and 35-Ampere, or greater, automatic battery charging alternator with solid-state voltage regulation. The starting battery shall be sized to provide a minimum of five full cranking cycles at a temperature of 20^{o} F without recharging.

Starting Batteries: Starting Batteries shall be nickel-cadmium type. Batteries shall be racked on corrosion resistant rack(s) located adjacent to the generator set or as shown on the Drawings. Line supplied and generator mounted charging alternator shall be configured to match battery type furnished with the generator set.

Battery Heater: Provide a line powered battery heater to maintain the temperature of the cranking battery no lower than 40 ^{o} F.

Starting Battery Disconnect: Provide a battery disconnect(s) capable of being locked on the "off" position with a hasp-type lock(s). The battery disconnect shall be electrically arranged such that when it is in the "off" position all battery voltage is effectively removed from the generator and related systems. The battery disconnect shall be configured to comply with OSHA Hazardous Energy (Lockout/Tagout) as described in 29 CFR 1910.147.

ENGINE-GENERATOR SET ACCESSORIES

Weather Protective Housing: Provide rust-resistant sound attenuating weather-protective housing for diesel generator unit made of heavy gage reinforced steel; mate and match to the unit enclosed, which permits proper cooling, and access to both controller and service points. Enclosure shall be vandal-resistant and lockable with pin-type locks; access panels, once unlocked, shall be removable without the use of tools. Doors shall permit escape from within, once locked from the outside. Overall, the structure shall be constructed to withstand loads imposed by 120 MPH winds. The maximum sound level permitted shall not exceed 74 dBA at a distance of 23 feet from the generator set enclosure. Ventilation opening louvers shall be motor operated for closed position and spring loaded for open position. All exterior components of the enclosure shall be assembled utilizing stainless steel hardware and all seams shall be sealed to prevent leaks. The enclosure shall be primed with a minimum of two (2) coats of rust inhibiting primer and two (2) finish coats. The color of the enclosure shall be the manufacturer's standard color.

Protective Enclosure Illumination: Provide switched illumination for the interior of the generator enclosure powered from the generator cranking battery system. Illumination shall be a minimum of 30 fc at all locations within the generator enclosure requiring maintenance or inspection. The switch for controlling

lights shall be a wind-up timer type, with a pre-set limit of 1 hour.

Provide factory-fabricated free standing automatic load-transfer switch control as specified in Section 263623, *AUTOMATIC AND NON-AUTOMATIC TRANSFER SWITCHES*.

Provide integral, UL-142 listed, double walled sub-base diesel tank,132 gallons useable capacity, completely installed under generator set upon arrival to job site.

Sub-Base tank assembly shall consist of a frame to support the total weight of the generator set with the fuel tank separate and contained within the frame. No generator weight is to be supported by the tank. The frame shall be constructed suitably to form a rupture basin for the tank if a leak should develop. Provide a drain plug at one end of the rupture basin. Provide vibration isolators between generator set and tank assembly. Provide fuel low level and leak detection alarm contacts to remote mounted annunciator.

The exterior surface of the sub-base tank assembly shall be protected from corrosion by the factory application of a corrosion-resistant coating. The sub-base tank shall be physically arranged such that the lower surface of the tank does not come into direct contact with the generator set concrete pad.

Provide remote annunciation system per NFPA 76A, 99, 101, and 110. Remote annunciator panels shall have visual and audible alarms to monitor and warn of emergency operating conditions affecting line and generator power sources. As a minimum the remote annunciator shall indicate the following:

Engine high-temperature shutdown.
Lube-oil low-pressure shutdown.
Overspeed shutdown.
Remote emergency-stop shutdown.
Engine high-temperature pre-alarm.
Lube-oil low-pressure pre-alarm.
Fuel tank low level.
Overcrank shutdown.
Coolant low-temperature alarm.
Control switch not in auto position.
Battery-charger malfunction alarm.
Battery low-voltage alarm.
Additional items as described elsewhere.

Remote Shutdown Switch: The remote annunciator panel shall have a red locking-type mushroom head emergency generator shut-down button either built into the annunciator panel or located adjacent to the annunciator panel location. Activation of the emergency shut-down button shall cause the generator to shut-down and shall illuminate a “generator not in automatic” light on generator control panel and the annunciator panel.

Provide engine block heater, (1500 Watt, 120 Volts, single phase) with thermostatic controls to maintain engine coolant at proper temperature to fulfill start-up requirements of NFPA 99. Block heater shall be de-energized when genset is running.

Provide line operated (120 VAC) float type battery charger connected to maintain the cranking battery in a charged condition. The battery charger shall be matched to the starting battery voltage and have panel mounted meters to indicate the charging current level and the voltage across the starting battery terminals. The charger shall have self-contained provisions for fault detection and shall be connected to the remote annunciator to indicate an overcharged, undercharged, or other abnormal condition of the starting batteries or charging system. The battery charger, when installed in the weatherproof housing, shall be suitable for use in wet locations.

Provide insulated critical grade exhaust silencer with drain, piping, and bellows adaptor, completely sealed, metal prime finish, mounted within generator enclosure. Thermal expansion of exhaust system shall not impose stress on engine assembly. Measured sound level at a distance of 10 feet from the exhaust discharge must be 85 dBA or less.

Provide anchor bolts of galvanized steel, of types and sizes recommended by the manufacturer.

Provide glycol base antifreeze coolant suitable for operation at -20^{o} F.

PART 3 - EXECUTION

EXAMINATION

Examine areas and conditions under which diesel engine-driven generator units are to be installed. Do not proceed with the Work until unsatisfactory conditions have been corrected.

INSTALLATION OF DIESEL ENGINE-DRIVEN GENERATOR SETS AND RELATED ITEMS

Install diesel engine-driven generator units as indicated, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that engine-generator units fulfill requirements. Comply with NFPA and NEMA standards pertaining to installation of engine-generator sets and accessories.

Coordinate with other work, including raceways, electrical boxes and fittings, fuel tank, piping, and accessories, as necessary to interface installation of engine-generator equipment work with other work.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A, B and the National Electrical Code.

Install units on vibration isolators in accordance with manufacturer's indicated method of installation. Secure the engine-generator-fuel tank assembly to the concrete mounting base with suitable anchor bolts.
Connect fuel oil piping to fuel tank as indicated and comply with manufacturer's installation instructions.

Align shafts of engine and generator within tolerances recommended by engine-generator unit manufacturer.

GROUNDING

Provide equipment grounding connections for diesel engine-driven generator units as indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounding.

FIELD QUALITY CONTROL

Start-up Testing:

Engage local equipment manufacturer's representative to perform start-up and building load tests upon completion of installation, with the A-E in attendance; provide certified test record. Tests are to include the following:

Check fuel, lubricating oil, and antifreeze in liquid cooled models for conformity to the manufacturer's recommendations under environmental conditions present.

Test prior to cranking engine for proper operation, accessories that normally function while the set is in a standby mode. Accessories include: engine heaters, battery charger, generator strip heater, remote annunciator.

Check, during start-up test mode, for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.

Test, by means of simulated power outage, automatic start-up by remote-automatic starting, transfer of load, and automatic shut-down. Prior to this test adjust, for proper system coordination, transfer switch timers. Monitor throughout the test, engine temperature, oil pressure, battery charge level, generator voltage, amperes, and frequency. The capability of the system to pick up full standby service load within 10 seconds

of power outage shall be demonstrated.

Measure voltage total harmonic distortion (THD) for each line-to-line (L-L) and line-to-neutral (L-N) combination at 50 kW increments up to rated power and at rated power factor.

Prior to acceptance of the installation, the generator shall be subjected to a 4-hour test. This test shall be performed at the job site by the equipment vendor and documented. It shall include 1 hour at 50% load, 1 hour at 75% load, 1 hour at 100% load and 1 hour at 50% load. Upon completion of the 4-hour load test, the generator shall be shut-down after the cooling period. The generator shall be started immediately upon reaching rated rpm, 100% load shall be applied to demonstrate one step full load capability.

Upon completion of installation demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Initial testing and retesting to be at no cost to Owner.

At the conclusion of testing and demonstrations fill the fuel tank to its rated capacity and verify that all other consumables are at their maximum level. Unless instructed otherwise by the A-E, leave the unit set up for automatic operation.

DOCUMENTATION

Prior to acceptance, the manufacturer shall supply three (3) copies of complete instruction manuals to the Owner. The manuals shall include operation and maintenance procedures, complete parts lists, dimensional drawings, unit wiring diagrams and schematics, and interconnection wiring drawings.

WARRANTY

The emergency generator, transfer switch and associated equipment shall be warranted by the manufacturer for a period of five (5) years, from the date of final inspection and acceptance. The warranty shall include all parts, labor (including travel and expenses) and equipment necessary to perform replacement and/or repairs.

PERSONNEL TRAINING

Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing, and operating diesel engine-driven generator sets. In addition, train Owner's personnel in periodic maintenance of batteries.

END OF SECTION 263213

SECTION 263623 - AUTOMATIC AND NON-AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in the manufacturing of transfer switches, of types and ratings required in this Section, whose products are Listed and Labeled for the purpose intended. Subject to compliance with requirements provide equipment equivalent to that provided by one of the following manufacturers:

Automatic Switch Company (ASCO)
Russelectric Inc.
Zenith Controls Inc.
Onan Corporation

Codes and Standards:

Electrical Code Compliance: Comply with applicable State electrical code requirements of the authority having jurisdiction and NEC as applicable to construction and installation of electrical power transfer switches.

Testing Laboratory Compliance: Comply with applicable requirements of UL 1008, "Automatic Transfer Switches," and UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide transfer switches and components that are Listed and Labeled.

NEMA Compliance: Comply with applicable requirements of NEMA Standards Pub/No.'s ICS 2, "Industrial Control Devices, Controllers and Assemblies," ICS 6 and 250, pertaining to transfer switches.

NFPA Compliance: Comply with applicable requirements of NFPA 99, "Standard for Health Care Facilities," and NFPA 101; "Code for Safety to Life from Fire in Buildings and Structures," pertaining to transfer switches.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Product Data: Submit manufacturer's data and installation instructions for electrical power transfer switches.

Shop Diagrams: Submit layout drawings of electrical power transfer switches showing accurately scaled equipment locations and spatial relationships to associated electrical equipment in proximity.

Wiring Diagrams: Submit wiring diagrams for electrical transfer switches, and associated control devices showing connections to prime and alternate power sources, electrical load, and equipment components. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

PART 2 - PRODUCTS

AUTOMATIC TRANSFER SWITCHES

General: Except as otherwise indicated, provide manufacturer's standard design, materials and components as indicated by published product information, designed, and constructed as recommended by manufacturer for duty indicated, and as required for a complete installation.

Automatic Transfer Switches: Provide a factory fabricated, listed per UL Standard 1008, automatic transfer switch and auxiliary equipment rated 150 Amperes, 240 Volts, 1 phase, 3 wire, 60 Hz, 3-pole. Neutral contacts shall have the same rating as the phase contacts. Switches shall be double throw construction, with positive electrical and mechanical interlocking by a simple mechanical beam to prevent simultaneous closing. Switch shall be mechanically held in both normal and emergency positions. The switch shall perform quick-make, quick-break operation. The switch shall be approved for manual operation under full load by integrally mounted, permanently attached manual operating handles. The switch operator shall be powered by 120 Volt AC sources provided by transformers within the transfer switch enclosure. Molded case circuit breaker type switches are not acceptable.

Provide wall or floor mounted welded steel NEMA Type 1 enclosure with swing out service panel and door locks. All transfer switch coils, springs, and control elements shall be easily visible and conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors. Main contacts shall be of silver alloy composition. Coat enclosure with manufacturer's standard color acrylic enamel finish over a corrosion-resisting primer.

Provide the Following Features in Addition to Automatic Transfer Function:

Remote engine starting contacts.

Indicating lights to indicate emergency transfer switch position: red for emergency power, green for normal power. Additional indicating lights for exercising mode active and in-phase monitor active. Provide a pushbutton test switch which simultaneously tests all indicator lights.

Solid state undervoltage sensors monitoring all three phases.

Provide exerciser clock to set the day, time and duration of generator set exercising period, including "WITH/WITHOUT LOAD" selector switch, 7-day dial minimum.

Provide battery charger, SCR voltage regulated type, float, and taper features, 6 Amp at 24 VDC, with charging ammeter and fuse protection.

One additional normally open contact on both normal and emergency relays.

One set of normally open auxiliary contacts for remote indication of normal power failure.

Programmed transition feature from 0.5 to 5.0 seconds.

Under/over frequency sensor for generator side of automatic transfer switch.

Panel mounted switch to control transfer switch position.

Terminal connector strip, pre-connected for external remote control of the transfer switch position.

The automatic transfer switch control panel for single-phase service shall utilize solid-state sensing on normal and emergency for automatic, positive operation. The following shall be provided:

For single-phase switches, all phases of the normal shall be monitored line-to-line.

Close differential voltage sensing shall be provided on all phases.

The pickup voltage shall be adjustable from 85 percent to 100 percent of nominal and the dropout voltage shall be adjustable from 75 percent to 98 percent of the pickup value.

The transfer to emergency will be initiated when source drops below a range of 70-95% of rated voltage (factory set at 85%). The transfer switch shall transfer to emergency as soon as the generator voltage has reached a range of 75-100% of rated voltage (factory set at 90%) and generator rated frequency of 85-100% (factory set at 90%).

A time delay to override momentary normal source outages to delay all transfer switch and engine starting signals.

The time delay shall be field adjustable from 0.5 to 6 seconds and factory set at three (3) seconds.

After restoration of normal power on all phases to 90% of rated voltage, an adjustable time delay period shall delay re-transfer to normal power until it has stabilized. If the emergency power source should fail during the time delay period, the time delay shall be bypassed and the switch shall return, immediately, to the normal source.

The time delay shall be field adjustable from 0 to 30 minutes and factory set at 5 minutes. Key operated bypass shall be provided.

An unloaded running time delay for emergency generator cool-down.

The time delay shall be field adjustable from 0 to 5 minutes and factory set at five (5) minutes.

A time delay on transfer to emergency.

Initially set at zero but field adjustable up to one (1) minute for controlled timing of load transfer to emergency, where indicated.

Independent single-phase voltage and frequency sensing of the emergency source.

The pickup of voltage shall be adjustable from 85% to 100% of nominal.

The pickup frequency shall be adjustable from 90% to 100% of nominal.

A contact that closes when normal source fails for initiating engine starting, rated 10 Amperes, 32 VDC.

Contacts to be gold plated for low voltage service.

Two (2) auxiliary contacts that are closed when transfer switch is connected to normal and two (2) auxiliary contacts that are closed when transfer switch is connected to emergency.

Rated 10 Amperes, 250 Volts, 60 Hz AC.

A test switch to momentarily stimulate normal source failure.

Generator exercising time switch with load/no-load selector switch.

PART 3 - EXECUTION

EXAMINATION

Examine areas and conditions under which automatic transfer switches are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

INSTALLATION OF TRANSFER SWITCHES

Install automatic transfer switches, including associated control devices as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that transfer switches comply with requirements. Comply with applicable requirements of NEC and NFPA pertaining to wiring practices and installation of electrical power transfer switches.

Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of transfer switch work with other work.

Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.

Equipment/System Identification: Provide equipment identification nameplates complying with Section 260533, *ELECTRICAL IDENTIFICATION*.

GROUNDING

Provide equipment grounding connections for transfer switch units as indicated. Tighten connectors to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounding.

Transfer switches shall be grounded by a separate insulated grounding conductor routed with feeders and connected to a grounding bus. The neutral, where used in transfer switches, shall not be connected to the grounding bus.

FACTORY TESTING

Certified laboratory test data on a switch of the same design and rating shall be provided to confirm the following switching abilities: Overload and endurance at 480 Volts AC per Tables 21.2, 23.1 and 23.2 of UL Standard No. 1008 when enclosed according to Paragraph 1.6; temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within the allowable temperature limits of the insulation in contact with current-carrying parts.

Withstand and Closing (WCR) Testing: Switches shall be tested in accordance with UL 1008 to close into and withstand fault currents according to the following table:

WITHSTAND CURRENT RATINGS WHEN USED WITH "ANY CIRCUIT BREAKERS"	
RMS Symmetrical Amps	
Switch Rating (Amps)	WCR
150	22,000

No welding of contacts will be permitted. Transfer switch must be operable to alternate source after the withstand current tests. Switch shall pass dielectric tests at 1,960 Volts, RMS, minimum after the withstand current test.

All Production Units Should Be Subjected to the Following Factory Tests: The complete automatic transfer switch shall be tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operation transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements; the switch shall be subjected to a dielectric strength test per NEMA Standard No. 1-109.21; the control panel shall meet or exceed the voltage surge withstand capability in accordance with IEEE Standard No. 472-1974 (ANSI Standard No. C37-.90a-1974) and the impulse withstand voltage test in accordance with the proposed NEMA Standard No. ICS 1-109.

The manufacturer shall provide a notarized letter certifying compliance with all the requirements of this specification. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the Specifications other than those stipulated at the time of submittal shall be included in the certification.

FIELD QUALITY CONTROL

Test transfer switches, by means of simulated power outage; automatic start-up by remote-automatic starting, transfer of load, and automatic shutdown. Prior to these tests, adjust transfer switch timers for proper system coordination.

Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of transfer switches with requirements. When possible, correct malfunctioning units at site then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Initial testing and retesting, where necessary, at no cost to Owner.

PERSONNEL TRAINING

Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing, and operating transfer switches and auxiliary equipment.

END OF SECTION 263623

SECTION 264313 – SURGE PROTECTIVE DEVICES (SPD)

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of contract, including General and Supplementary Conditions and Division-1 specification sections apply to work of this section.

QUALITY ASSURANCE

Manufacturers: Firms regularly engaged in manufacture of surge protective devices, of types and ratings required in this Section, whose products are Listed and Labeled for the purpose intended. Subject to compliance with requirements provide equipment equivalent to that provided by one of the following manufacturers:

Current Technology
LEA International
Emerson Network Power

Codes and Standards:

NEC Compliance: Comply with applicable requirements of NEC.

National Standards Compliance: Comply with applicable requirements of UL 1449, 4th Edition and ANSI/IEEE Standard C62.72-2007.

UL Compliance:

All AC power protection SPD units shall meet requirements of UL 1449, 4th Edition as Surge Protective Devices. Product must be labeled with testing laboratory mark. All AC power protection SPD installed in equipment housing(s) or electrical distribution panels shall be additionally Listed as recognized components.

Warranty: Provide the written Manufacturer's warranty statement agreeing to replace any SPD device that fails in service for not less than ten (10) years. Provide written Manufacturer's warranty statement for any connected equipment warranty.

All warranty replacements must be without cost, excluding costs related to shipping and/or installation except that SPD devices that show evidence of failure for a period of two (2) years from the date of acceptance by the Owner, shall be replaced or repaired including shipping and labor costs.

SUBMITTALS

Submittals shall be made in strict accordance with the requirements of Section 019913. Specific submittal requirements are defined in each section of this Division.

Submit product data and manufacturer information on each SPD model or type provided under this Section. As a minimum the submittal data shall include:

A. Manufacturer's part or model number(s)

B. Manufacturer's specification(s)

C. Installation instructions

D. All UL ratings and file numbers

E. Copy of manufacturer's product warranty

F. Dimensional drawing of each SPD type indicating physical dimensions, mounting arrangements, connection types, and grounding connections required

Upon request from the A-E, provide Manufacturer's certified test data for each type of SPD device indicating compliance with this Section.

PART 2 - PRODUCTS

General: This section describes the materials and installation requirements for SPD devices. SPD devices shall be installed for protection of AC electrical circuits and equipment from the effects of lightning, substation, and internally generated surges.

AC Electrical Distribution Systems:

Where indicated on the drawings, main service equipment, distribution panelboards and branch circuit panelboards shall be protected with a secondary surge protective device. This secondary surge protective device shall meet the requirements of NEC Article 280 and meet ANSI/IEEE Standard C62.11 (Revision 2008) for location Type 2 service entrance equipment.

The SPD shall provide suppression elements as listed below to provide SPD protection in all modes for the voltage level specific to the application:

240 VAC
- Phase to Phase
- Phase to Neutral (single phase)
- Phase to Ground
- Neutral to Ground

Secondary Service Protective Devices (Branch Circuit Panelboards):

SPD shall be certified by the Manufacturer to fail open.

SPD shall provide visible LED indicator lights to confirm proper connection and operation.

SPD shall be closed-nippled to the panelboard being protected. The mounting position of the SPD shall permit a straight and short lead length connection between the SPD and the point of connection to the panel board. Do not exceed manufacturer's recommended lead length. Connections utilizing conduit between the protective devices and panelboards are not acceptable.

SPD shall meet or exceed the following criteria:

A. Single pulse surge current rating: 50 kA per mode/100 kA per phase.

B. Repetitive surge current rating: 3,250 impulses per mode

C. Nominal discharge current rating: 10,000 amps

D. Voltage protective rating when tested to UL 1449 standards:

Phase voltage (RMS)	UL Voltage Protective Rating (Peak Volts)			
	L-L	L-N	L-G	N-G
240 Volts (wye)	1000	600	600	600

SPD shall have a turn-on time of less than or equal to five nanoseconds (5 nS).

SPD shall be bi-directional.

SPD operating temperature: -40°C to +60°C

PART 3 - EXECUTION

Install SPD devices at all locations where indicated or described on the Drawings.

Service Entrance Equipment (Switchboard):

Install one (1) each SPD device at each utility service entrance to the facility. Installation shall be according to the Manufacturer's instructions.

Installation shall be in accordance with NEC Article 280, and meet all State and local codes. SPD device shall be installed on the first distribution section of switchboard.

SPD device shall be installed with a circuit breaker for each phase protected; use multi-pole circuit breakers as required. This circuit breaker is to be positioned to allow for the shortest possible connecting wire length between the SPD device and the wire termination for neutral and ground connections. Locate SPD above distribution section, where necessary to meet this requirement.

SPD device ground shall be bonded to the service entrance grounding conductor and grounded conductor.

Distribution and Branch Circuit Panelboards:

Install one (1) SPD device at each panelboard location indicated on the drawings.

SPD device shall be installed on the load side of the panel.

SPD device shall be installed with a circuit breaker for each phase protected; use multi-pole circuit breakers as required. This circuit breaker is to be positioned to allow for the shortest possible connecting wire length between the SPD device and the wire termination for neutral and ground connections.

SPD device grounds shall be bonded to the electrical panelboard ground. The grounding and grounded conductor shall be bonded to the service entrance ground. All ground references between service panels shall be common.

FIELD QUALITY CONTROL

Prior to energizing equipment protected by SPD, visually inspect installation to verify proper use of devices and proper electrical connections.

Subsequent to device connection, energize equipment and demonstrate proper operation. Replace malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 264313