

ADVERTISEMENT FOR BIDS

Sealed proposals will be received until 3:00 PM on November 20, 2025 at Cleveland Community College, 137 S. Post Road, Shelby, NC 28152 in the Jack Hunt Building, Room 2071, for the construction of:

Cleveland Community College Paksoy and Multi-Use Facility HVAC Make Up Air Upgrade at which time and place bids will be opened and read.

A non-mandatory pre-bid conference will be held on November 6, 2025 in the same location as above, Jack Hunt Building, Room 2071.

Complete plans and specifications for this project can be obtained from AeroRaq Engineering, Inc. 8511 davis Lake Parkway, Suite C6 - 205, Charlotte, NC 26269 Attn: Hakeem Bailey hakeembailey@aerorag.com and available only to prime bidders after October 15, 2025. (704)469-8463.

The state reserves the unqualified right to reject any and all proposals.

Cleveland Community College
Paksoy and Multi-purpose facility
Make Up Air Upgrade

FOR:

Cleveland Community College
Facilities Services

137 South Post Rd.
Shelby, NC 28152

09/29/2025



ARCHITECT

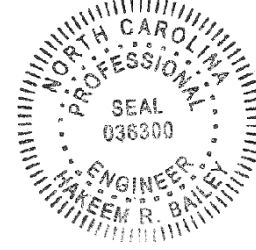
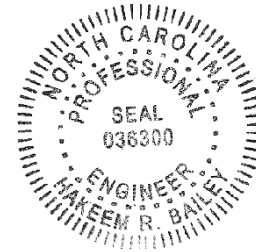
Structural Engineer

Mechanical
EngineerAeroRaq Engineering Inc
8511 Davis Lake Parkway
Suite C6 - 205
Charlotte, NC 26269

Electrical Engineer

AeroRaq Engineering Inc
8511 Davis Lake Parkway
Suite C6 - 205
Charlotte, NC 26269

Civil Engineer



A. INTRODUCTORY INFORMATION

Cover Sheet
Seals Page
Table of Contents

B. PROCUREMENT AND CONTRACTING REQUIREMENTS

Notice & Instructions to Bidders
Informal Contract - Bid Proposal / Acceptance Form
General Conditions of the Contract
Supplementary Conditions of the Contract

C. TECHNICAL SPECIFICATIONS:

01 01 10 Summary of Concrete
01 73 10 Cutting and Patching
03 05 00 Common Work Results for Concrete
09 09 00 Painting
23 05 93 Testing Adjusting and Balancing
23 07 16 HVAC Insulation
23 31 00 HVAC Ducts and Casing
23 37 13 Diffusers, Registers and Grilles
23 73 00 Indoor Central Station Air Handling Units
23 74 00 Packaged Outdoor HVAC Equipment
26 05 00 Common Work Results for Electrical
26 05 19 Low Voltage Power Conductors and Cables
26 05 26 Grounding and Bonding for Electrical Systems
26 05 53 Identification for Electrical Systems
26 27 26 Wiring Devices
26 28 16 Enclose Switches and Breakers

END OF TABLE OF CONTENTS

NOTICE TO BIDDERS

Sealed proposals will be received by the **Owner –Cleveland Community College, 137 South Post Rd.**
Shelby, NC 28152 up to 3:00 pm on **Nov 20, 2025**, for the furnishing
of labor, material and equipment entering into the construction of the Make Up Air Upgrade.

Bids will be received for single prime contracts only . All proposals shall be lump sum.

All contractors are hereby notified that they must have proper license as required under the state laws governing their respective trades.

NOTE: The bidder shall identify on its bid proposal the minority business participation it will use on the project. Forms are included within the Proposal Form in the bid documents. Failure to complete these forms is grounds for rejection of the bid. (GS143-128.2c Effective 1/1/2002.)

CONTRACTOR'S LICENSE: General contractors are notified that Chapter 87, Article 1, General Statutes of North Carolina, will be observed in receiving and awarding general contracts. General contractors submitting bids on this project must have license classification for unlimited general construction.

NOTE: Under GS 87-1, a contractor that superintends or manages construction of any building, highway, public utility, grading, structure, or improvement shall be deemed as "general contractor" and shall be so licensed. Therefore, a single prime project that involves other trades will require the single prime contractor to hold a proper General Contractors license.

In the case of separate prime or dual bidding, Plumbing, mechanical and electrical prime contractors are notified that General Statutes Chapter 87, Articles 2 & 4, will be observed in receiving and awarding plumbing, mechanical and electrical contracts.

Payment will be made based on ninety-five percent (95%) of monthly estimates and final payment made upon completion and acceptance of work.

AWARD OF THE CONTRACT: No bid may be withdrawn after the scheduled closing time for the receipt of bids for a period of 30 days. *The Bidder shall guarantee its Bid for a period of ninety (90) calendar days from the date of the opening.* Award of this contract is subject to approval by the Board of Trustees of Cleveland Community College. The Owner reserves the right to waive informalities and to reject any and all bids.

OWNER'S RIGHTS RESERVED: The owner reserves the right to cancel this Notice Inviting Bids at any time, and further reserves the right to reject all submitted bids, without giving any reason for such action, at its sole discretion and without liability. All costs incurred by Bidders, as a result of preparing Bids under this Notice Inviting Bids, shall be the sole responsibility of each Bidder. This Notice Inviting Bids creates no obligation upon the OWNER to enter into a contract.

PROJECT ADMINISTRATION: All communications relative to this PROJECT shall be directed to **Hakeem R Bailey** no later than seven (7) days prior to opening of the Bids at the following address:

*** Minority and Women Business Enterprises are Highly Encouraged to Apply ***

INSTRUCTIONS TO BIDDERS

Sealed bid for this work will be received by:

*Mark Fox, Director of Capital Projects
Cleveland Community College
137 South Post Rd, Shelby, NC 28152,
704-330-6234*

up to **3:00 PM**, on Nov 20th, 2025 and immediately thereafter publicly opened and read aloud. Complete plans and specification and contract documents can be obtained from

*AeroRaq Engineering Inc
8511 Davis Lake Parkway, Suite C6-205
Charlotte, NC 28269
704-469-8463*

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 Plumbing license classification for Mechanical (HVAC).

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 PROPOSAL FORM provided herein with all blank spaces for bids properly filled in and all signatures properly executed.

Please note on the envelope – **Bid : Attn:** Mark Fox

*Make Up Air Upgrade
November 20, 2025
(Contractor)
(License Number)*

There will be a voluntary pre-bid meeting held on Thursday, Nov 06th, 2025 at 2:00 pm. The meeting will be held at the work site, 137 South Post Rd. Shelby, NC 28152.

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

FOR

Cleveland Community College Paksoy and Multi-Use Facility Make Up Air Upgrade

SCOPE OF WORK

Remove and replace dedicated outdoor air handler with a split outdoor air handler and condensing unit for cooling and dehumidification of outside air. Remove and replace two packaged rooftop units on the multi-purpose facility. New thermostats will be provided. There is an alternate for adding patio heaters on the exterior of the multi-purpose facility.

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. General Contractors must have general license classification for limited 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/ACCEPTANCE form provided herein with all blank spaces for bids properly filled in and all signatures properly executed.

BID/ACCEPTANCE FORM

for

*Paksoy and Multi-Use Facility
HVAC Make Up Air Upgrade*

The undersigned, as bidder, proposes and agrees if this bid is accepted to contract with the *State of North Carolina* through Cleveland Community College 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 Cleveland Community College for the sum of:

BASE BID: _____ **Dollars \$** _____

ALTERNATE :1 BID: _____ **Dollars \$** _____

Respectively submitted this _____ day of _____ 20____

(Contractor's Name)

Federal ID#: _____

By: _____

Witness: _____

Title: _____

(Owner, partner, corp. Pres. Or Vice President)

(Proprietorship or Partnership)

Address: _____

Attest: (corporation)

Email Address: _____

(Corporate Seal)

By: _____ License #: _____

Title: _____

(Corporation, Secretary./Ass't Secretary.)

ACCEPTED by the STATE OF NORTH CAROLINA

through the

Cleveland Community College

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

BY:_____TITLE:_____

Date: _____

GENERAL CONDITIONS

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 (*Cleveland Community College*)

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 at 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 amount 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 in 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 (160) consecutive calendar days from the Notice to Proceed

LIQUIDATED DAMAGES

For each day in excess of the above number of days, the Contractor shall pay the Owner the amount of Dollars (\$ 500.00) 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 any time 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.

CONSTRUCTION SCHEDULE:

To be determined.

PERMITS:

The Owner will pay for building permit and plan review fees associated with this project.

UTILITIES

Owner shall provide access to existing power and water. Any required connections and/or extensions shall be by the Contractor. Use of existing toilets, parking, access, etc. must be coordinated with and approved by Owner

SECURITY

Access to the site shall be coordinated with CCC Security. Firearms, any type of alcoholic beverages, drugs (other than those prescribed by a physician), smoking or loud music will not be permitted on the site.

USE OF SITE

Contractor shall have limited use of premises for construction operations, including limited use of Project site, during construction period. Contractor's use of premises is limited by the need of the Owner to maintain the functionality of the existing the existing building and the surrounding campus adjacent to the building, including the adjacent sidewalks. The construction lay-down area and parking area will be coordinated with the Owner.

DECORUM:

Everyone at the project site is expected to exhibit proper behavior. Indecent language, acts or dress will not be accepted. Anyone in violation of proper behavior will be ejected from the construction site by the proper authorities.

FIRE ALARM WORK:

Contractor for fire alarms shall be approved by Design and Construction Services Department prior to beginning work.

SECTION 01 01 10 - SUMMARY OF WORK

PART 1: GENERAL

1.1 WORK COVERED BY THE CONTRACT DOCUMENTS

- A. The project consists of demolition and renovation work associated with construction of new heating, ventilating and air conditioning system. Project work will be done in and around occupied spaces. The plumbing, mechanical and electrical contractors shall be licensed in the state of North Carolina.
- B. The location of the project is Shelby, North Carolina.
Single Prime Contract consists of General construction, Mechanical and Electrical

1.2 SCOPE

CONSTRUCTION CONTRACT: The scope of this contract included in the Base Bid Documents may be described generally as, but is not limited to, the following:

Building Mechanical:

Heating, ventilating and air conditioning systems

Building Electrical:

Equipment circuit wiring and fuses

Panel board and power distribution

1.3 DRAWINGS AND SPECIFICATIONS

Drawings and specifications are listed in the Table of Contents of this Project Manual, showing divisions and related Sections.

Following are the specific drawings and specifications sections which apply to the specific Contract, and which will be included in the Contract Documents for the Contractors.

(1) Construction Contract:

- (a) Drawings: see Table of Contents.
- (b) Specifications: see Table of Contents

END OF SECTION 010110

SECTION 01 73 10 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Divisions of the Technical Specifications, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Divisions 2 through 48, of the Technical Specifications Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements in this Section apply to mechanical and electrical installations.

1.3 DEFINITIONS

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

1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch any of the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Air or smoke barriers.
 - 3. Fire-protection systems.
 - 4. Control systems.
 - 5. Communication systems.
 - 6. Conveying systems.
 - 7. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or those results in increased maintenance or decreased operational life or safety.
 - 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
 - 3. Exterior curtain-wall construction.
 - 4. Equipment supports.

-
5. Piping, ductwork, vessels, and equipment.
 6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.

1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of the Technical Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION:

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

-
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of the Technical Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

END OF SECTION 01 73 10

SECTION 03 05 00 – COMMON WORK RESULTS FOR CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings: M1.1 & M2.1

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Poured and cured concrete
 - 2. Concrete supporting rebar

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following requirements apply for product selection:
 - 1. Manufacturers: Use standard manufacturers of concrete, steel and iron products

2.2 CONCRETE PRODUCTS

- A. Manufacturers:
 - 1. Use standard concrete supply manufacturers

2.3 STEEL AND IRON PRODUCTS

- A. Manufacturers:
 - 1. Use standard rebar supply manufacturers

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Contractor shall add concrete to support equipment. The surface shall be cleaned and prepped for concrete pouring and concrete to concrete adhesion. Support rebar shall be installed in semi-solid concrete. New concrete shall be allowed to properly cure and harden before it is placed in service.
- B. Contractor shall roughen and scour the surface of designated concrete equipment pads. The surface shall be cleaned and prepped for concrete pouring and concrete to concrete adhesion. Support rebar shall be installed in semi-solid concrete. New concrete pad shall be allowed to properly cure and harden before unit is placed on top of pad and securely fastened.
- C. Refer to plan drawings for further details.

END SECTION 030500

SECTION 09 90 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
 - 1. Exposed exterior items and surfaces.
 - 2. Exposed interior items and surfaces.
 - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Do not paint pre-finished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Pre-finished items include the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Acoustical wall panels.
 - c. Finished mechanical and electrical equipment.
 - d. Light fixtures.
 - e. Distribution cabinets.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.

- b. Stainless steel.
 - c. Chromium plate.
 - d. Copper.
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Related Sections include the following:
- 1. Division 2 Section "Hot-Mix Asphalt Paving" for traffic-marking paint.
 - 2. Division 2 Section "Portland Cement Concrete Paving" for traffic-marking paint.
 - 3. Division 5 Section "Structural Steel" for shop priming structural steel.
 - 4. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
 - 5. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
 - 6. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.
 - 7. Division 9 Section "Wall Coverings" for substrate sealer under wall coverings.
 - 8. Divisions 15 and 16: Painting of mechanical and electrical work is specified in Divisions 15 and 16, respectively.
- E. Alternates: Refer to Division 1 Section "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
- 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
 - 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
 - 4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.4 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
- 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
 1. After color selection, the Architect will furnish color chips for surfaces to be coated.
- C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
 3. Submit Samples on the following substrates for the Architect's review of color and texture only:
 - a. Concrete: Provide two 4-inch- (100-mm-) square samples for each color and finish.
 - b. Concrete Masonry: Provide two 4-by-8-inch (100-by-200-mm) samples of masonry, with mortar joint in the center, for each finish and color.
 - c. Stained or Natural Wood: Provide two 4-by-8-inch (100-by-200-mm) samples of natural- or stained-wood finish on actual wood surfaces.
 - d. Ferrous Metal: Provide two 4-inch- (100-mm-) square samples of flat metal and two 8-inch- (200-mm-) long samples of solid metal for each color and finish.
- D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.
 1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft. (9 sq. m) of wall surface.
 - b. Small Areas and Items: The Architect will designate an item or area as required.
 2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.

- a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.
3. Final approval of colors will be from job-applied samples.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F (7.2 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.
 1. Quantity: Furnish the Owner with extra paint materials in the quantities indicated below:
 - a. Exterior, Flat Acrylic Paint: One case of each color applied.

- b. Exterior, Low-Luster Acrylic Finish: One case of each color applied.
 - c. Exterior, Semigloss Acrylic Enamel: 2 gal. (7.57 L) of each color applied.
 - d. Exterior, Full-Gloss Alkyd Enamel: 2 gal. (7.57 L) of each color applied.
 - e. Interior, Flat Acrylic Paint: One case of each color applied.
 - f. Interior, Low-Luster Acrylic Finish: One case of each color applied.
 - g. Interior, Semigloss Acrylic Enamel: 2 gal. (7.57 L) of each color applied.
 - h. Interior, Full-Gloss Alkyd Enamel: 1 gal. (3.785 L) of each color required.
2. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal. (3.785 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules.
- B. Products: Subject to compliance with requirements, provide one of the products in the paint schedules.
- C. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
 1. Devoe & Raynolds Co. (Devoe).
 2. Fuller-O'Brien Paints (Fuller).
 3. Glidden Co. (The) (Glidden).
 4. Benjamin Moore & Co. (Moore).
 5. Pratt & Lambert, Inc. (P & L).
 6. Sherwin-Williams Co. (S-W).

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: Provide color selections made by the Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

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

- b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
 - c. When transparent finish is required, back-prime with spar varnish.
 - d. Back-prime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
- 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- 5. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

6. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer on metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
1. Piping, pipe hangers, and supports.
 2. Heat exchangers.
 3. Tanks.
 4. Ductwork, including interiors at grilles.
 5. Insulation.
 6. Motors and mechanical equipment.
 7. Accessory items.
- G. Electrical items to be painted may include, but are not limited to, the following:
1. Conduit and fittings.
 2. Switchgear.

3. Panel boards.

- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - 1. Provide satin finish for final coats.
- L. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Low-Luster Acrylic Finish: 2 finish coats over a rust-inhibitive primer.

- a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.
 - 1) Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.
 - 2) Fuller: 621-04 Blox-Rust Alkyd Metal Primer.
 - 3) Glidden: 5205 Glid-Guard Tank & Structural Primer, Red.
 - 4) Moore: IronClad Retardo Rust-Inhibitive Paint #163.
 - 5) P & L: S/D 1009 Suprime "9" Interior/Exterior Alkyd Metal Primer.
 - b. First and Second Coat: Low-sheen (eggshell or satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
 - 1) Devoe: 16XX Wonder-Shield Exterior Latex Satin House and Trim Paint.
 - 2) Fuller: 261-XX Eggshell Sheen Latex House and Trim Paint.
 - 3) Glidden: 6700 Series Spred Ultra Exterior Satin Latex House and Trim Paint.
 - 4) Moore: MoorGard Latex House Paint #103.
 - 5) P & L: Z/F 4200 Series Accolade Exterior Eggshell.
- B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated (galvanized) metal surfaces:
- 1. Low-Luster Finish: 2 finish coats over a galvanized metal primer.
 - a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
 - 1) Devoe: 8502/8520 Mirrolac Interior/Exterior Waterborne Flat DTM Primer and Finish.
 - 2) Fuller: 621-05 Blox-Rust Latex Metal Primer.
 - 3) Glidden: 5205 Glid-Guard Tank & Structural Primer, Red.
 - 4) Moore: IronClad Galvanized Metal Latex Primer #155.
 - 5) P & L: Z/F 1003 Suprime "3" Interior/Exterior Latex Metal Primer.
 - b. First and Second Coat: Low-luster (eggshell or satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
 - 1) Devoe: 16XX Wonder-Shield Exterior Acrylic Latex Satin House and Trim Paint.
 - 2) Fuller: 261-XX Eggshell Sheen Latex House and Trim Paint.
 - 3) Glidden: 6700 Series Spred Ultra Exterior Satin Latex House and Trim Paint.
 - 4) Moore: MoorGard Latex House Paint #103.
 - 5) P & L: Z/F 4200 Series Accolade Exterior Eggshell.

3.7 INTERIOR PAINT SCHEDULE

- A. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block units:
 - 1. Semigloss, Alkyd-Enamel Finish: 2 finish coats over an undercoat and a filled surface.
 - a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils.

- 1) Devoe: 52902 Bloxfil 200 Interior/Exterior Latex Block Filler.
 - 2) Fuller: 280-00 Interior/Exterior Latex Block Filler.
 - 3) Glidden: 5317 Ultra-Hide Block Filler, Latex Interior-Exterior.
 - 4) Moore: Moorcraft Interior & Exterior Block Filler #173.
 - 5) P & L: Z 98 Pro-Hide Plus Latex Block Filler.
 - 6) S-W: Heavy-Duty Block Filler B42W46.
- b. Undercoat: Interior, alkyd- or latex-based, enamel undercoater, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
- 1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.
 - 2) Fuller: 220-07 Interior Alkyd Enamel Undercoat.
 - 3) Glidden: UH 400 Ultra-Hide Alkyd Interior Enamel Undercoater.
 - 4) Moore: Moore's Alkyd Enamel Underbody #217.
 - 5) P & L: S/D 1012 Suprime "12" Interior Alkyd Wall Primer.
 - 6) S-W: Classic 99 Interior/Exterior Semi-Gloss Alkyd Enamel A-40 Series.
- c. Finish Coat: Odorless, semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
- 1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.
 - 2) Fuller: 206-XX Interior Alkyd Semi-Gloss Enamel.
 - 3) Glidden: UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel.
 - 4) Moore: Satin Impervo #235.
 - 5) P & L: S/D 5700 Series Cellu-Tone Alkyd Satin Enamel.
 - 6) S-W: Classic 99 Interior/Exterior Semi-Gloss Alkyd Enamel A-40 Series.
- B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
1. Semigloss, Alkyd-Enamel Finish: 2 finish coats over a primer.
 - a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
 - 1) Devoe: 50801 Wonder-Tones Interior Vinyl Latex Primer-Sealer.
 - 2) Fuller: 220-20 Pro-Tech Interior Latex Wall Primer and Sealer.
 - 3) Glidden: 5111 Spred Ultra Latex Primer-Sealer.
 - 4) Moore: Regal First Coat Interior Latex Primer & Underbody #216.
 - 5) P & L: Z/F 1001 Suprime "1" 100 Percent Acrylic Multi-Purpose Primer.
 - 6) S-W: ProMar 200 Interior Latex Wall Primer B28W200. - b. First and Second Coats: Odorless, semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
 - 1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.
 - 2) Fuller: 206-XX Interior Alkyd Semi-Gloss Enamel.
 - 3) Glidden: UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel.
 - 4) Moore: Moore's Alkyd Dulamel #207.
 - 5) P & L: S/D 5700 Cellu-Tone Alkyd Satin Enamel.
 - 6) S-W: Classic 99 Interior Alkyd Semi-Gloss Enamel A-40 Series.
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss, Alkyd-Enamel Finish: One finish coat over an enamel undercoater and a primer.
 - a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
 - 1) Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.
 - 2) Fuller: 621-04 Blox-Rust Alkyd Metal Primer.
 - 3) Glidden: 5207 Glid-Guard Tank & Structural Primer, White.
 - 4) Moore: IronClad Retardo Rust-Inhibitive Paint #163.
 - 5) P & L: S 4551 Tech-Gard High Performance Rust Inhibitor Primer.
 - 6) S-W: Kem Kromik Metal Primer B50N2/B50W1.
 - b. Undercoat: Alkyd, interior enamel undercoat or semigloss, interior, alkyd-enamel finish coat, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
 - 1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.
 - 2) Fuller: 220-07 Interior Alkyd Enamel Undercoat.
 - 3) Glidden: UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel.
 - 4) Moore: Moore's Alkyd Enamel Underbody #217.
 - 5) P & L: S/D 1011 Suprime "11" Interior Alkyd Wood Primer.
 - 6) S-W: ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200.
 - c. Finish Coat: Odorless, semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.4 mils.
 - 1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.
 - 2) Fuller: 110-XX Fullerglo Alkyd Semi-Gloss Enamel.
 - 3) Glidden: UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel.
 - 4) Moore: Satin Impervo #235.
 - 5) P & L: S/D 5700 Cellu-Tone Alkyd Satin Enamel.
 - 6) S-W: Classic 99 Interior/Exterior Semi-Gloss Alkyd Enamel A-40 Series.
- D. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:
 1. Semigloss, Alkyd-Enamel Finish: One finish coat over an undercoat and a primer.
 - a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
 - 1) Devoe: 13201 Mirrolac Galvanized Metal Primer.
 - 2) Fuller: 621-05 Blox-Rust Latex Metal Primer.
 - 3) Glidden: 5207 Glid-Guard Tank & Structural Primer, White.
 - 4) Moore: IronClad Galvanized Metal Latex Primer #155.
 - 5) P & L: Z/F 1003 Suprime "3" Interior/Exterior Latex Metal Primer.
 - 6) S-W: Galvite Paint B50W3.
 - b. Undercoat: Alkyd, interior enamel undercoat or semigloss, interior, alkyd-enamel finish coat, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.

- 1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.
 - 2) Fuller: 220-07 Interior Alkyd Enamel Undercoat.
 - 3) Glidden: UH 8400 Series Spred Ultra Traditional Alkyd Semi-Gloss Enamel.
 - 4) Moore: Moore's Alkyd Enamel Underbody #217.
 - 5) P & L: S/D 1011 Suprime "11" Interior Alkyd Wood Primer.
 - 6) S-W: ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200.
- c. Finish Coat: Odorless, semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.4 mils.
- 1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.
 - 2) Fuller: 110-XX Fullerglo Alkyd Semi-Gloss Enamel.
 - 3) Glidden: UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel.
 - 4) Moore: Satin Impervo #235.
 - 5) P & L: S/D 5700 Cellu-Tone Alkyd Satin Enamel.
 - 6) S-W: Classic 99 Interior Alkyd Semi-Gloss Enamel A-40 Series.

END OF SECTION 09 90 00

SECTION 23 05 93 – TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:

1. Air Systems:

- Constant-flow systems.
- 2. HVAC equipment quantitative-performance settings.
- 3. Space pressurization testing and adjusting.
- 4. Indoor-air quality measuring.
- 5. Verifying that automatic control devices are functioning properly.
- 6. Reporting results of activities and procedures specified in this Section.

1.2 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- M. TAB: Testing, adjusting, and balancing.
- N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- O. Test: A procedure to determine quantitative performance of systems or equipment.
- P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

PART 2 - PRODUCTS

2.1 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified herein.

- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Sample Report Forms: Submit two sets of sample TAB report forms.
- D. Warranties specified in this Section.

2.2 QUALITY ASSURANCE

- A. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- B. TAB Report Forms: Use standard forms from TAB firm's forms approved by Engineer.
- C. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- D. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- E. Balancing Contractor shall be certified in National Environmental Balancing Bureau(NEBB) or Associated Air Balance Council (AABC) and submit qualifying documentation to engineer prior to TAB being performed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow- control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- D. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- F. Examine system and equipment test reports.
 - a. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - b. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 - c. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
 - d. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
 - e. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
 - f. Examine strainers for clean screens and proper perforations.
 - g. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
 - h. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
 - i. Examine system pumps to ensure absence of entrained air in the suction piping.
 - j. Examine equipment for installation and for properly operating safety interlocks and controls.
 - k. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating
 - 10. Changeover from heating to cooling mode occurs according to indicated values.

- G. Report deficiencies before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in latest edition of SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan- speed-control levers, and similar controls and devices, to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust- air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.

- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 2. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan- motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check expansion tank liquid level.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive- displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated pre-settings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.

3.11 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.13 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.

-
2. Project name.
 3. Project location.
 4. Engineer's name and address.
 5. Contractor's name and address.
 6. Report date.
 7. Signature of TAB firm who certifies the report.
 8. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 9. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 10. Nomenclature sheets for each item of equipment.
 11. Data for terminal units, including manufacturer, type size, and fittings.
 12. Notes to explain why certain final data in the body of reports varies from indicated values.
 13. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.

- c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - g. Cooling coil static-pressure differential in inches wg (Pa).
 - h. Heating coil static-pressure differential in inches wg (Pa).
 - i. Outside airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outside-air damper position.
 - l. Return-air damper position.
- F. Apparatus-Coil Test Reports:
 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch (mm) o.c.
 - f. Make and model number.
 - g. Face area in sq. ft. (sq. m).
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outside-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Water flow rate in gpm (L/s).
 - i. Water pressure differential in feet of head or psig (kPa).
 - j. Entering-water temperature in deg F (deg C).
 - k. Leaving-water temperature in deg F (deg C).
 - l. Inlet steam pressure in psig (kPa).

G. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Test apparatus used.
- d. Area served.
- e. Air-terminal-device make.
- f. Air-terminal-device number from system diagram.
- g. Air-terminal-device type and model number.
- h. Air-terminal-device size.
- i. Air-terminal-device effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm (L/s).
- b. Air velocity in fpm (m/s).
- c. Preliminary airflow rate as needed in cfm (L/s).
- d. Preliminary velocity as needed in fpm (m/s).
- e. Final airflow rate in cfm (L/s).
- f. Final velocity in fpm (m/s).
- g. Space temperature in deg F (deg C).

3.14 INSPECTIONS

A. Final Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report. Test and Balance will be submitted to engineer of record to review and be approved prior to requesting Final Inspection and Occupancy Permit.

END OF SECTION 230593

SECTION 23 07 19 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes mechanical insulation for duct, equipment, and pipe, including the following:
1. Insulation Materials:
 - Mineral Fiber.
 - Flexible elastomeric.
 2. Insulating cements.
 3. Adhesives.
 4. Mastics.
 5. Lagging adhesives.
 6. Sealants.
 7. Factory- applied jackets.
 8. Field- applied fabric- reinforcing mesh.
 9. Field- applied cloths.
 10. Field- applied jackets.
 11. Tapes.

1.2 DEFINITIONS

- A. ASJ: All- service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVDC: Polyvinylidene chloride.
- E. SSL: Self- sealing lap.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Show details for the following:
1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 3. Removable insulation at piping specialties, equipment connections, and access panels.
 4. Application of field- applied jackets.

5. Application at linkages of control devices.
6. Field application for each equipment type.

1.4 QUALITY ASSURANCE

- B. Insulation Installed Indoors: Flame- spread index of 25 or less, and smoke- developed index of 50 or less.
- C. Insulation Installed Outdoors: Flame- spread index of 75 or less, and smoke- developed index of 150 or less.

1.3 COORDINATION

- A. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field- applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

3.2 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
 1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
 2. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
 3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
 4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
 5. All mineral fiber for duct and plenum shall be minimum 1 1/2" thick and meet have an R value of 6 for type 1.
 6. All flexible elastomeric insulation for hydronic pipe shall be minimum 2" thick and have an minimum R value of 8.
 7. All exterior foam insulation for exterior ductwork shall be minimum 1 1/2" thick and have an minimum R value of 8 with aluminum jacket.

- B. Mineral- Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory- applied FSK jacket. Factory- applied jacket requirements are specified in Part 2 "Factory- Applied Jackets" Article.

1.1 Available Products:

1. CertainTeed Corp.; Duct Wrap.
2. Johns Manville; Microlite.
3. Knauf Insulation; Duct Wrap.
4. Manson Insulation Inc.; Alley Wrap.
5. Owens Corning; All- Service Duct Wrap.

- C. Mineral- Fiber, Preformed Pipe Insulation:

1.1 Available Products:

1. Fibrex Insulations Inc.; Coreplus 1200.
2. Johns Manville; Micro- Lok.
3. Knauf Insulation; 1000(Pipe Insulation.
4. Manson Insulation Inc.; Alley- K.
5. Owens Corning; Fiberglas Pipe Insulation.

- 1.2 Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory- applied ASJ- SSL. Factory- applied jacket requirements are specified in Part 2 "Factory- Applied Jackets" Article.

- 1.3 Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory- applied ASJ- SSL. Factory- applied jacket requirements are specified in Part 2 "Factory- Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL- A- 24179A, Type II, Class I.

1. Available Products:

- a. Aeroflex USA Inc.; Aeroseal.
- b. Armacell LCC; 520 Adhesive.
- c. Foster Products Corporation, H. B. Fuller Company; 85- 75.
- d. RBX Corporation; Rubatex Contact Adhesive.

- C. Mineral- Fiber Adhesive: Comply with MIL- A- 3316C, Class 2, Grade A.

1. Available Products:

- a. Childers Products, Division of ITW; CP- 82.
- b. Foster Products Corporation, H. B. Fuller Company; 85- 20.
- c. ITW TACC, Division of Illinois Tool Works; S- 90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon- Eco Industries, Inc.; 22- 25.

- D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Available Products:

- a. Dow Chemical Company (The); 739, Dow Silicone.
- b. Johns- Manville; Zeston Perma- Weld, CEEL- TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL- C- 19565C, Type II.
- B. Vapor- Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Available Products:

- a. Childers Products, Division of ITW; CP- 35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30- 90.
 - c. ITW TACC, Division of Illinois Tool Works; CB- 50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon- Eco Industries, Inc.; 55- 40.
 - f. VimaCity of Greensboro Corporation; 749.
2. Water- Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43- mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL- A- 3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Available Products:

- Childers Products, Division of ITW; CP- 52.
 - Foster Products Corporation, H. B. Fuller Company; 81- 42.
 - Marathon Industries, Inc.; 130.
 - Mon- Eco Industries, Inc.; 11- 30.
 - VimaCity of Greensboro Corporation; 136.
2. Fire- resistant, water- based lagging adhesive and coating for use indoors to adhere fire- resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:

1. Available Products:

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water- resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
1. Available Products:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H- 14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - Same material, finish, and thickness as jacket.
 - Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - Tee covers.
 - Flange and union covers.
 - End caps.
 - Beveled collars.
 - Valve covers.
 - Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
 1. Available Products:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
 1. Available Products:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
1. Available Products:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Verify that systems and equipment to be insulated have been tested and are free of defects.
- C. Verify that surfaces to be insulated are clean and dry.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. 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.
 - 3. 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.
 - 4. 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.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. 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.
 - 3. 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 4 inches o.c.
 - 4. For below ambient services, apply vapor-barrier mastic over staples.
 - 5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 DUCT AND PLENUM INSULATION INSTALLATION

- A. In the 2nd floor mechanical room and over variable air volume boxes install blanket insulation. Installation on ducts and plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to the bottom and both sides of ducts and to surfaces of fittings and transitions. Adhesive on the top of the duct can be omitted.
 3. 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 as follows:
- B. 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.
- 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.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles. The pipe insulation is applied in the boiler room piping and the hot water piping to AHU-2 in the upstairs mechanical room.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, and flanges. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

A Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. 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.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to 3-sides of ducts and to all surfaces of fittings and transitions. Adhesive is not required on the top of the duct.
 3. 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 as follows:
 - a. 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.
 - b. 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.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

- F. 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor- barrier seal.
 2. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) 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 2 times the insulation thickness but not less than 3 inches (75 mm).
 3. 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.
 4. 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.
 5. 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.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

END SECTION 230719

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round spiral-seam ducts and formed fittings.
3. Single-wall flat oval duct and formed fittings.

1.2 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer.

1.3 QUALITY ASSURANCE

A. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Use Standard Manufacturers for sheet metal using materials that comply Section 2.02 Sheet Materials

2.2 SHEET METAL MATERIALS

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

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 SEALANT MATERIALS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

D. Duct Mastic typ. #8 mastic low high velocity air sealant

2.4 HANGERS AND SUPPORTS

A. Attached Hangers and supports as necessary to secure ducts and maintain minimal deflection per SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

2.5 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod

applications, and joint types and intervals.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.
- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- E. Install ducts within classroom previous duct locations and through ceiling support bar joists.
- F. Seal all traverse, radial and longitudinal seams in ducts with #8 mastic low high velocity air sealant.

3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
 - 1. For pressure classes lower than 2-inch wg, seal transverse joints with duct mastic.
 - 2. For pressure classes 2-inches wg and above, seal longitudinal and transverse joints with duct mastic
- B. Seal ducts with #8 mastic low high velocity air sealant before external insulation is applied.

3.3 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

3.4 DUCT CLEANING

- A. All supply duct and fittings for new custom air-handling unit must be thoroughly cleaned and capped in fabrication shop before delivery to project site.

END SECTION 233100

SECTION 23 37 13 - DIFFUSERS, REGISTERS, & GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - a. Hart & Cooley
 - b. Price
 - c. Metalaire
 - d. Ruskin

2.2 GRILLES AND REGISTERS

- A. Refer to schedule on drawings M0.1 for design and sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Engineer for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END SECTION 233713

SECTION 23 73 00 – INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 – GENERAL

1.1 SUMMARY

- A. This section will include the installation of two central station air handlers that work in conjunction with rooftop condensers located in the second floor mechanical room.

1.2 QUALITY ASSURANCE

- A. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.3 COORDINATION - UNUSED

1.4 SUBMITTALS

- A. Equipment selections shall be submitted to engineer or record for approval before purchasing.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Choose an equipment manufacturer whose equipment meets the requirements of the system design and complies with all provisions herein, including but not limited to NFPA 70
- B. The system must be third party UL listed and labeled
- C. Available manufacturers include but are not limited to:
 - 1. Aaon
 - 2. SpartanAire Custom DX
 - 3. LG

2.2 EQUIPMENT

- A. The equipment selected shall be equivalent to the following selection and performance requirements:
 - 1. Air handler 1(MU-1); 6300 CFM, 3 HP, 1.0 in. wc. ESP, 480 V

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Identify and mark electrical power supply through wire troughs.
- B. Identify and mark the existing ductwork fittings and connections from supply, return and outside air duct work.
- C. Identify and mark all sensors and control points installed in the AHU's.

3.2 COMMON INSTALLATION REQUIREMENTS

- A. Remove the return air duct work.
- B. Remove the return air louvers and dampers.
- C. Install air handlers on vibration where the old units were set add addition supporting sheaves and blocks as necessary to level units.
- D. Follow manufacturer's installation instructions
- E. Anchor and fasten units to the vibration pad.
- F. Install supply, return and outside air ducts to new air handlers
- G. Replace the return air louvers and dampers, replace pneumatic actuators with electronic control dampers.

3.3 START-UP

- A. Air handler shall be started up per manufacturer's instructions.
- B. Start-up shall be supervised by a factory certified technician.
- C. After equipment has started up and is operating under standard conditions

3.4 TRAINING

A. Training on how to operate the system shall be done by a factory certified technician and shall include air handlers and controls. The training time shall be requested and approved by the Cleveland Community College project manager. Contractor will have a sign-in sheet to record the attendees of the training and submit a copy of the record to the engineer.

END OF SECTION 23 73 00

SECTION 23 74 00 - PACKAGED OUTDOOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Roof top air handling units including integral components specified herein.
- B. Definitions: Roof Top Air Handling Unit(Roof Top Units, RTU): A factory fabricated assembly consisting of fan, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying, and mixing of air. Design capacities of units shall be as scheduled on the drawings.

1.2 RELATED WORK

- A. Section 23 31 00, HVAC DUCTS and CASINGS: Requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining.

1.3 QUALITY ASSURANCE

- A. Refer to Article, Quality Assurance, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Air Handling Units Certification
 - 1. Air Handling Units with Housed Centrifugal Fans: The air handling units shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
 - 2. Air Handling Units with Plenum Fans:
 - a. Air Handling Units with a single Plenum Fan shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
 - b. Air handling Units with Multiple Fans in an Array shall be tested and rated in accordance with AHRI 430 and AHRI 260.
- C. Heating, Cooling, and Air Handling Capacity and Performance Standards: AHRI 430, AHRI 410, ASHRAE 51, and AMCA 210.
- D. Performance Criteria:
 - 1. The fan BHP shall include all system effects for all fans and v-belt drive losses for housed centrifugal fans.
 - 2. The fan motor shall be selected within the rated nameplate capacity, without relying upon NEMA Standard Service Factor.
 - 3. Select the fan operating point as follows:
 - a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point.
 - b. Air Foil, Backward Inclined, or Tubular Fans Including Plenum Fans: At or near the peak static efficiency but at an appropriate distance from the stall line.
 - 4. Operating Limits: AMCA 99 and Manufacturer's Recommendations.
- E. Units shall be factory-fabricated, assembled, and tested by a manufacturer, in business of manufacturing similar air-handling units for at least five (5) years.

1.4 SUBMITTALS:

- A. The contractor shall furnish a complete submission for all roof top units covered in the project. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without reviews.
- B. Manufacturer's Literature and Data:
 - 1. Submittals for RTUs shall include fans, drives, motors, coils, filter housings, and all other related accessories. The contractor shall provide custom drawings showing total air handling unit assembly including

- dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, lights, duplex receptacles, switches, wiring, utility connection points, unit support system, vibration isolators, drain pan, pressure drops through each component (filter, coil etc) and rigging points.
2. Submittal drawings of section or component only, will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details; if the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements.
 3. Submit sound power levels in each octave band for fan and at entrance and discharge of RTUs at scheduled conditions. Include sound attenuator capacities and itemized internal component attenuation. Internal lining of supply air ductwork with sound absorbing material is not permitted.
 4. Provide fan curves showing Liters/Second (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design Liters/Second (cubic feet per minute) and 110 percent of design static pressure.
 5. Submit total fan static pressure, external static pressure, for RTU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule on drawings.
- C. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS. Include instructions for lubrication, filter replacement, motor and drive replacement, spare part lists, and wiring diagrams.
- D. Submit written results of factory tests for approval prior to shipping.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
- 260-01.....Sound Rating of Ducted Air Moving and Conditioning Equipment
 - 410-01.....Standard for Forced-Circulation Air-Heating and Air-Cooling Coils
 - 430-09.....Standard for Central Station Air Handling Units
 - AHRI-DCAACP Directory of Certified Applied Air Conditioning Products
- C. Air Moving and Conditioning Association (AMCA):
- 210-07.....Laboratory Methods of Testing Fans for Rating
- D. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):
- 9-90 (R2008).....Load Ratings and Fatigue life for Ball Bearings
- E. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
- 51-2007.....Laboratory Methods of Testing Fans for Rating
- F. American Society for Testing and Materials (ASTM):
- A653/653M-02 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - B117-07a Salt Spray (Fog) Testing
 - C1071-05e1 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
 - D1654-08 Standard Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
 - D1735-08 Water Resistance of Coatings Using Water Fog Apparatus
 - D3359-08 Standard Test Methods for Measuring Adhesion by Tape Test
 - E84-10 Standard Test Method for Surface Burning Characteristics of Building Materials

- G. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):
9-90.....Load Ratings and Fatigue life for Ball Bearings
- H. National Fire Protection Association (NFPA):
NFPA 90A.....Standard for Installation of Air Conditioning and Ventilating Systems,
2009
- J. Energy Policy Act of 2005 (P.L.109-58)

PART 2 - PRODUCTS

2.1 ROOF TOP AIR HANDLING UNITS

- A. General:
 - 1. Roof top units (RTU) shall be fabricated from insulated, solid double-wall galvanized steel without any perforations in draw-through configuration. Casing is specified in paragraph 2.1.C. Galvanizing shall be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.275 kg of zinc per square meter (0.90 oz. of zinc per square foot) (G90). Aluminum constructed units may be provided subject to GCS approval and documentation that structural rigidity is equal or greater than the galvanized steel specified.
 - 2. The contractor and the RTU manufacturer shall be responsible for insuring that the unit will not exceed the allocated space shown on the drawings, including required clearances for service and future overhaul or removal of unit components. All structural, piping, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost to the government.
 - 3. RTUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
 - 4. The RTU manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a local representative at the job site to supervise the assembly and to assure the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation that this representative has provided this service on similar jobs to the Contracting Officer. If a local representative cannot be provided, the manufacturer shall provide a factory representative.
 - 5. Gaskets: All door and casing and panel gaskets and gaskets between air handling unit components, if joined in the field, shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.
 - 6. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed 1/200 of the span based on a differential static pressure of 1991 Pa (8 inches water gage) or higher.
 - 7. Corrosion Protection:
 - a. Coil Treatment: Epoxy Immersion Coating–Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV

exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:

- 1) Salt Spray Resistance (Minimum 6,000 Hours)
 - 2) Humidity Resistance (Minimum 1,000 Hours)
 - 3) Water Immersion (Minimum 260 Hours)
 - 4) Cross-Hatch Adhesion (Minimum 4B-5B Rating)
 - 5) Impact Resistance (Up to 160 Inch/Pound)
- b. Casing Surfaces (Exterior and Interior): All exposed and accessible exterior and interior metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) and 500 hours UV resistance (ASTM D4587).
- B. Base:
1. Provide a heavy duty steel base for supporting all major RTU components. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 125 mm (5 inch) high 3.5 mm (10 Gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for cooling coil condensate drain trap as shown on drawings.
 2. RTUs shall be completely self-supporting for installation on roof curb.
 3. The RTU bases not constructed of galvanized material shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.
- C. Casing (including wall, floor and roof):
1. General: RTU casing shall be entirely double wall insulated panels, integral of or attached to a structural frame. Construction shall be such that removal of any panel shall not affect the structural integrity of the unit. Casing finished shall meet salt-spray test as specified in paragraph 2.1.C.10. All casing and panel sections shall be tightly butted and gasketed. No gaps of double wall construction will be allowed where panels bolt to air handling unit structural member. Structural members, not covered by the double wall panels, shall have equivalent insulated double wall construction.
 2. Double wall galvanized steel panels, minimum 51 mm (2 inches) thick, constructed of minimum 1.3 mm (18 gauge) outer skin and 1.0 mm (20 gauge) solid or perforated inner skin. to limit wall, roof and floor deflection to not exceed an L/240 ratio when the unit casing is pressurized to (± 1245 Pa (± 5 in. w.g.)). Deflection shall be measured at the midpoint of the panel height. Total housing leakage shall not exceed 1% of rated cfm when the unit casing is pressurized to ± 5 in. w.g. (± 1245 Pa). The outer (skin) and inner panels shall be solid.
 3. Blank-Off: Provide blank-offs as required to prevent air bypass between the AHU sections, around coils, and filters.
 4. Insulation: Insulation shall be injected CFC free foam encased in double-wall casing between exterior and interior panels such that no insulation can erode to the air stream. Insulation shall be 50 mm (2 inch) thick, and 48 kg/m^3 (3.0 lb/ft^3) density with a total thermal resistance (R-value) of approximately 2.3 m.K/W ($13.0 \text{ hr-ft}^2 \text{ }^\circ\text{F/BTU}$). Units with less than 50 mm (2 inch) of insulation in any part of the walls, floor, roof or drain pan shall not be acceptable. The insulation shall comply with NFPA 90-A for the flame and smoke generation requirements.

Table 2.1.C.4

Outer Panel	0.8 mm (22 Gage) Minimum
Inner Panel	0.8 mm (22 Gage) Minimum
Insulation Thickness	Foam 50 mm (2 inch) Minimum

Density	48 kg/m ³ (3.0 lb/ft ³) Minimum
Total R Value	2.3 m ² .K/W (13.0 ft ² .°F.hr/Btu) Minimum

5. The thickness of insulation, mode of application, and thermal breaks shall be such that there is no visible condensation on the exterior panels of the AHU.
6. Casing panels shall be secured to the support structure with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications. Welded exterior panels are not acceptable.
7. Access Doors: Provide in each access section and where shown on drawings. Show single-sided and double-sided access doors with door swings on the floor plans. Doors shall be a minimum of 50 mm (2 inches) thick with same double wall construction as the unit casing. Doors shall be a minimum of 600 mm (24 inches) wide, unless shown of different size on drawings, and shall be the full casing height up to a maximum of 1850 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal. The access doors for fan section, mixing box, coil section shall include a minimum 150 mm x 150 mm (6 inch x 6 inch) double thickness, with air space between glass panes tightly sealed, reinforced glass or Plexiglas window in a gasketed frame.
 - a. Hinges: Manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 pound) weight hung on latch side of door.
 - b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside. Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45 degrees) further movement of the handle for complete opening. Latch shall be capable of restraining explosive opening of door with a force not less than 1991 Pa (8 inches water gage).
 - c. Gaskets: Neoprene, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.
8. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and pneumatic tubing. Coordinate with electrical and temperature control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.
9. Roof of the unit shall be sloped to have a minimum pitch of 1/4 inch per foot. The roof shall overhang the side panels by a minimum of three inches to prevent precipitation drainage from streaming down the unit side panels.
- D. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 pounds per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation. Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.
- E. Condensate Drain Pan: Drain pan shall be designed to extend entire length of cooling coils including headers and return bends. Depth of drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be double wall construction, Type 304 stainless steel and have a minimum of 50 mm (2 inch) insulation, and shall be sloped to drain. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.

1. An intermediate condensate drip pan shall be provided on stacked cooling coils and shall be constructed of type 304 stainless steel with copper downspouts factory piped to main condensate pan. Use of intermediate condensate drain channel on upper casing of lower coil is permissible provided it is readily cleanable. Design of intermediate condensate drain shall prevent upper coil condensate from flowing across face of lower coil.
 2. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
 3. Installation, including frame, shall be designed and sealed to prevent blow-by.
- F. Housed Centrifugal Fan Sections:
1. Fans shall be minimum Class II construction, double width, double inlet centrifugal, air foil or backward inclined or forward curved type as indicated on drawings, factory balanced and rated in accordance with AMCA 210 or ASHRAE 51. Provide self-aligning, pillow block, regreasable ball-type bearings selected for a B(10) life of not less than 40,000 hours and an L(50) average fatigue life of 200,000 hours per AFBMA Standard 9. Extend bearing grease lines to motor and drive side of fan section. Fan shall be located in airstream to assure proper air flow.
 2. Provide internally vibration isolated fan, motor and drive, mounted on a common integral bolted or welded structural steel base with adjustable motor slide rail with locking device. Provide vibration isolators and flexible duct connections at fan discharge to completely isolate fan assembly. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- G. Fan Motor, Drive, and Mounting Assembly (Housed Centrifugal Fans):
1. Fan Motor and Drive: Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005.
 2. Fan drive and belts shall be factory mounted with final alignment and belt adjustment to be made by the Contractor after installation. Drive and belts shall be as specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide additional drive(s) if required during balancing, to achieve desired airflow.
- H. Plenum Fans – Single and/or Multiple Fans in an Array
1. General: Fans shall be Class II (minimum) construction with single inlet, aluminum wheel and stamped air-foil aluminum bladed. The fan wheel shall be mounted on the directly-driven motor shaft in AMCA Arrangement 4. Fans shall be dynamically balanced and internally isolated to minimize the vibrations. Provide a steel inlet cone for each wheel to match with the fan inlet. Locate fan in the air stream to assure proper flow. The fan performance shall be rated in accordance with AMCA 210 or ASHRAE 51.
 2. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC. The fan wheel shall meet or exceed guidelines in AMCA 801-92 for dynamic balancing requirements. The complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).
 3. The plenum fans shall be driven by variable speed drives with at least one back-up drive as shown in the design documents. Use of a drive with bypass is not permitted.
 4. Fan Accessories
 - a. Fan Isolation: Provide a manual blank off plate to isolate the fan not in operation due to failure.

- b. Fan Airflow Measurement: Provide an airflow measuring device integral to the fan to measure air volume within +/- 5 percent accuracy. The probing device shall not be placed in the airflow path to stay clear of turbulence and avoid loss of performance.
- 6. Fan Motor, Drive and Mounting Assembly: Fan Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005
- I. Diffuser Section: Furnish a diffuser segment with perforated diffuser plate immediately downstream of supply fan to assure uniform distribution of leaving air across the face of the downstream after-filters to create uniform velocity profiles across the entire opening. Bolt or weld diffuser plate to a sturdy steel support frame so that it remains rigid. Manufacturer shall include any diffuser section pressure loss in excess of diffuser plate and this value shall be included in unspecified internal losses when selecting fan.
- J. Coils: Coils shall be mounted on hot dipped galvanized steel supports to assure proper anchoring of coil and future maintenance. Coils shall be face or side removable for future replacement thru the access doors or removable panels. Each coil shall be removable without disturbing adjacent coil. Cooling coils shall be designed and installed to insure no condensate carry over. Provide factory installed extended supply, return, drain, and vent piping connections
- K. Discharge Section: Provide aerodynamically designed framed discharge openings or spun bellmouth fittings to minimize pressure loss.
- L. Electrical and Lighting: Wiring and equipment specifications shall conform to Division 26, ELECTRICAL.
 - 1. Vapor-proof lights using cast aluminum base style with glass globe and cast aluminum guard shall be installed in access sections for fan, mixing box, and any section over 300mm (12 inch) wide. A switch shall control the lights in each compartment with pilot light mounted outside the respective compartment access door. Wiring between switches and lights shall be factory installed. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for field connection to the building system. Provide single point 115 volt - one phase connection at junction box.
 - 2. Install compatible 100 watt bulb in each light fixture.
 - 3. Provide a convenience duplex, weatherproof receptacle next to the light switch.
 - 4. Disconnect switch and power wiring: Provide factory or field mounted disconnect switch. Coordinate with Division 26, ELECTRICAL.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install roof top unit in conformance with ARI 435.
- B. Assemble roof top unit components following manufacturer's instructions for handling, testing and operation. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air-handling units clean prior to operation.
- C. Leakage and test requirements for roof top units shall be the same as specified for ductwork in Specification Section 23 31 00, HVAC DUCTS AND CASINGS except leakage shall not exceed Leakage Class (CL) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.
- E. Seal and/or fill all openings between the casing and RTU components and utility connections to prevent air leakage or bypass.

3.2 STARTUP SERVICES

- A. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated and fan has been test run under observation.

- B. After the air handling unit is installed and tested, provide startup and operating instructions to GCS personnel.
- C. An authorized factory representative should start up, test and certify the final installation and application specific calibration of control components. Items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Owner/Operator training

END SECTION 237400

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings: E0.1, E1.1, E1.2

1.2 SUMMARY

- A. This section includes the following;
1. Electrical equipment coordination and installation.
 2. Common electrical installation requirements.

1.3 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible service space surrounding equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.

2.2 INSPECTIONS

A. Contractor shall contact the County inspector to schedule electrical inspections and to schedule a final inspection.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
B. Comply with NEC
C. Comply with North Carolina Electrical Building Code
D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Provide and install power (wire and conduit) to AHUs.
B. Provide and install power (wire and conduit) to RTUs.
C. Provide and install power (wire and conduit) to condensing unit.

END SECTION 260500

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings: E0.1, E1.1, E1.2

1.2 SUMMARY

- A. This section includes the following
 - 1. Requirements for building wire and cable

1.3 COORDINATION

- A. Coordinate electrical testing of electrical items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.
- B. All building wire and cables should be listed by a North Carolina "approved" third party testing agency.

2.2 INSPECTIONS

- A. Contractor shall contact the County inspector to schedule electrical inspections and to schedule a final inspection.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Provide and install an individual neutral wire for each branch circuit.
- B. Conductors for power and lighting that are sized #10 AWG and smaller shall be solid copper conductors. All power conductors that are #8 AWG and larger shall be class B stranded copper conductors.
- C. The minimum size for power branch circuit wiring is #12 AWG.
- D. Fire alarm and control wiring may be equipped with stranded conductors that are sized #14 AWG.
- E. Branch circuit conductors should be sized to prevent a voltage drop exceeding (3%) and the maximum voltage drop on both feeders and branch circuits should not exceed (5%)
- F. Provide and install a full size individual neutral wire for each circuit.
- G. The insulation type for interior wiring shall be dual-rated THHN/THWN or XHHW.
- H. Where the conductor length from the panel to the first outlet on a 277 volt circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.
- I. Where the conductor length from the panel to the first outlet on a 120 volt circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.
- J. Joints in solid conductors shall be spliced using Ideal "wirenuts", 3M Company "Scotchlock" or T&B connectors in junction boxes, outlet boxes and lighting fixtures.
- K. "Sta-kon" or other permanent type crimp connectors shall not be used for branch circuit connections.
- L. Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with U/L-approved insulating covers, may be used instead of mechanical connectors plus tape.
- M. 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.
- N. The feeder, branch circuits shall be color coded.

END SECTION 260519

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings: E0.1, E1.1, E1.2

1.2 SUMMARY

- A. This section includes the following
 - 1. Grounding and bonding for raceways

1.3 COORDINATION

A. Coordinate electrical testing of electrical items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.
- B. All building wire and cables should be listed by a North Carolina “approved” third party testing agency

2.2 INSPECTIONS

A. Contractor shall contact the County inspector to schedule electrical inspections and to schedule a final inspection.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. The raceway system shall not be relied on for ground continuity. A green grounding conductor, properly sized per NEC Table 250-122, shall be run in all power raceways.”
- B. Provide and install a green grounding conductor in all power
- C. Test grounding and bonding system with a ground resistance tester demonstrating the resistance to ground is less than 25 ohms. Where the resistance is more than 25 ohms additional grounding will be required.
- D. Grounding conductors, where insulated, shall be colored solid green. Conductors intended as neutral shall be colored solid white on 120/208 volt circuits and natural gray on 277/480 volt circuits.

END SECTION 260526

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings: E0.1, E1.1, E1.2

1.2 SUMMARY

- A. This section includes the following
 1. Identification and labeling electrical systems

1.3 COORDINATION

- A. Electrician will properly label all electrical equipment with labels.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Furnish and install engraved laminated phenolic nameplates for all safety switches, panel boards, transformers, switchboards, motor control centers and other electrical equipment supplied for the project for identification. Nameplates shall be securely attached to equipment with self-tapping stainless steel screws; if the screw sharp end is protected; otherwise Rivets shall be used. Letters shall be approximately 1/2 inch high minimum. Embossed, self-adhesive plastic tape is not acceptable for marking equipment. Nameplate material colors shall be:

1. Blue surface with white core for 120/208 volt equipment.
2. Black surface with white core for 277/480 volt equipment.
3. Bright red surface with white core for all equipment related to fire alarm system.
4. Dark red (burgundy) surface with white core for all equipment related to security.
5. Green surface with white core for all equipment related to "emergency" systems.
6. Orange surface with white core for all equipment related to telephone systems.
7. Brown surface with white core for all equipment related to data systems.
8. White surface with black core for all equipment related to paging systems.
9. Purple surface with white core for all equipment related to TV systems.

B. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.

C. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined above. This includes covers on boxes above lift-out and other type accessible ceilings.

END SECTION 260553

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings: E0.1, E1.1, E1.2, E1.3

1.2 SUMMARY

- A. This section includes the following
 1. Specifications for the installations of wiring devices

1.3 COORDINATION

- A. Coordinate electrical testing of electrical items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.
- B. Device shall be third party tested.

2.2 INSPECTIONS

- A. Contractor shall contact the County inspector to schedule electrical inspections and to schedule a final inspection.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Toggle switches shall be single pole, three-way, or four-way as indicated on the drawings. Switches shall be of the grounding type, with hex-head grounding screw, rated 20A, 120/277 volt, A.C only. Lighted handle switches shall have neon lights of the correct voltage rating where indicated on the drawings. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be listed by an "approved" third-party agency, approved for the voltage and amperage indicated.
- B. Duplex receptacles shall be of the grounding type, arranged for back and side wiring, with separate single or double grounding terminals. Receptacles shall be straight blade, rated 20A, 125 volt and the face configuration shall conform to the NEMA Standard No. WD-1, NEMA WD-6, DSCC W-C-596G & UL-498, and shall be "approved" third-party listed. Self-grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
- C. Receptacles shall be industrial specification heavy duty grade, mounted vertically. Receptacles mounted over counters, back-splashes, etc., shall be mounted horizontally.
- D. GFCI receptacles shall be rated minimum 20amp (NEMA 5-20R configuration).
- E. Cover plates for flush mounted wiring devices and for telephone outlets shall be Type "302" stainless steel or nylon type, standard size, single or ganged as shown on the drawings. Cover plate mounting screws shall be slotted head oval screws and shall match the finish and material of the plate, and shall be furnished with the plate by the plate manufacturer. Quantity of 2% spare cover plates of each type shall be provided to the owner.
- F. Switch and receptacle cover plates on exposed work shall be galvanized cast ferrous metal, standard size, and shall be single or ganged as indicated on the drawings.
- G. Exterior mounted switch and receptacle plates, and those noted to be weatherproof, shall be weatherproof PVC cover plates, standard size, single or ganged as indicated on the drawings, and shall be "approved" third party listed as "rain-tight while in use."

END SECTION 262726

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings: E0.1, E1.1, E1.2

1.2 SUMMARY

A. This section includes the following

1. Specifications for the installations of safety switches

1.3 COORDINATION

A. Coordinate electrical testing of electrical items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.

B. Device shall be third party listed.

2.2 INSPECTIONS

A. Contractor shall contact the County inspector to schedule electrical inspections and to schedule a final inspection.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Comply with NEC

C. Comply with North Carolina Electrical Building Code

3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Safety switches shall be the "heavy duty" type. General duty switches are not acceptable.

B. Switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "on" position.

C. Switches shall have handles whose positions are easily recognizable in the "on" or "off" position. For safety reasons, padlock shall be provided for switches located in the public areas. D. Switches shall have non-teasible, positive, quick make-quick break mechanisms.

E. Switches shall be properly labeled.

END SECTION 262816

Scope of Work

This project involves the replacement of a make up air unit with a dehumidification enabled make up air unit. The roof top units on the baseball field house will be replaced.
ALTERNATE 1: Add two patio style unit heaters.

General Requirements & Notes:

1. All work shall comply with the North Carolina Building Code
2. All mechanical work shall be done by trained and qualified technicians
3. All electrical work shall be done by trained and qualified electricians
4. Install mechanical equipment in accordance with manufacturers recommendations
5. Drawings and documents are diagrammatic and are intended to convey scope and general arrangements unless otherwise indicated
6. Contractor is responsible for surveying site conditions and determining the best route for equipment, wiring, ducting, piping and conduits
7. Contractor will notify engineer immediately if an issue arises that cannot be immediately resolved
8. Install equipment to allow manufacturers recommended clearances
9. Provide a 48 hour notice before any power or gas shutdown
10. Seal Penetrations through floors or fire walls to maintain the integrity of the fire and acoustic ratings of the walls and floors.
11. All trades shall coordinate their work with the other disciplines to maintain schedule integrity.
12. Submittals drawings and paperwork will be approved by engineer before equipment and materials will be ordered
13. Not all abbreviations may apply to this project.

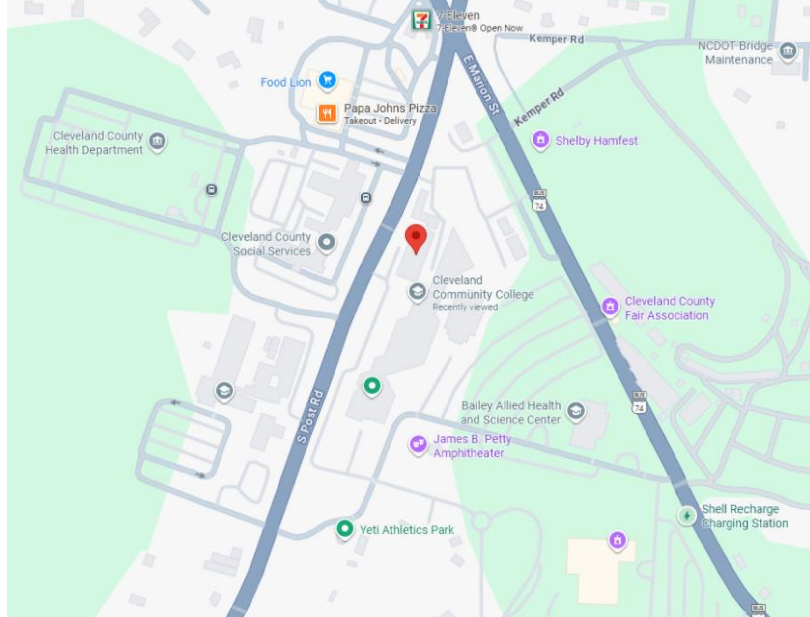
Design Complies with the 2018 North Carolina Building Code

Cleveland Community College



Shelby, North Carolina
Make Up Air Upgrade

Site Address: 137 South Post Rd. Shelby NC 28152



Location Map

Schedule of Drawings

A0.1 Cover Sheet
A0.2 Appendix B

M0.1 Mechanical Schedules
M1.0 Mechanical Demo Plan
M1.1 Mechanical Plan
M1.2 Mechanical Plan
M2.1 Mechanical Details
M3.1 Mechanical Controls

E0.1 Electrical Schedules
E1.1 Electrical Plan
E1.2 Electrical Plan
E3.1 Electrical Details

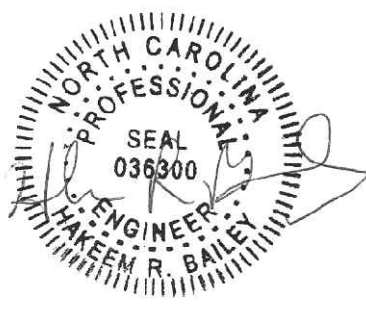
Abbreviations and References

NFPA - National Fire Protection Agency
SMANCA - Sheet Metal & Air Conditioning Contractor's National Association
NCFG - North Carolina Fuel Gas Code
NCMC - North Carolina Mechanical Code
NEC - National Electric Code
NEMA - National Electrical Manufacturers Association
ANSI - American National Standards Institute
UL - Underwriters Laboratory

AFF - Above Finished Floor
AFG - Above Finished Grade
AFUE - Annual Fuel Utilization Efficiency
APPROX - Approximate
ALUM - Aluminum
BFF - Below Finished Floor
BFG - Below Finished Grade
BHP - Brake Horse Power
CAP. - Capacity
CFM - Cubic Feet per Minute
CONN. - Connection
COORD. - Coordinate
CU. FT. - Cubic Foot
DB - Dry Bulb
DISTR. - Distribution
DWG. - Drawing
DX - Direct Expansion
ETR - Existing to remain
ESP - External Static Pressure
EQUIV. - Equivalent
EXH. - Exhaust
FPM - Feet per Minute
GALV. - Galvanized
Hp - Horse Power
KW - Kilowatt
MCA - Minimum Circuit Ampacity
MIN. - Minimum
NC - Normally Closed
NO - Normally Open
NPSH - Net Positive Suction Head
O.A. - Outside Air
Occup. - Occupancy
PSI - Pounds per Square Inch
QTY. Quantity
RECT. - Rectangular
RPM - Revolutions per Minute
SCH. - Schedule
SEER - Seasonal Energy Efficiency Rating
SENS. - Sensible
SPEC. - Specification
Sq ft. - Square Feet
TYP. - Typical Installation / Materials
UON - Unless Otherwise Noted
VAV - Variable Air Volume
VRV - Variable Refrigerant Volume
WB - Wet Bulb

AeroRaq Engineering Inc
Engineering Services
8511 Davis Lake Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/2025

Revisions

No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT

Project No:
01-2025015

Scale: N/A

Date: 09-16-2025

Title: Cover Sheet

G0.1

2018 APPENDIX B
BUILDING CODE SUMMARY FOR ALL COMMERCIAL PROJECTS
(EXCEPT 1 AND 2-FAMILY DWELLINGS AND TOWNHOUSES)
(Reproduce the following data on the building plans sheet 1 of 2)

Name of Project: Make Up Air Upgrade
Address: 137 South Post Rd. Shelby NC Zip Code: 28152
Owner/Authorized Agent: Carlos Guevara Phone # (718) 415 3351 E-Mail: guevara@cleveleadco.edu
Owned By: Private
Code Enforcement Jurisdiction: County

CONTACT:

DESIGNER	FIRM	NAME	LICENSE #	TELEPHONE #	E-MAIL
Architectural				()	
Civil				()	
Electrical	AeroRaq Engineering	Hakeem Bailey	036300	(704)469 8463	hakeembaily@aerorag.com
Fire Alarm				()	
Plumbing	AeroRaq Engineering	Hakeem Bailey	036300	(704)469 8463	hakeembaily@aerorag.com
Mechanical	AeroRaq Engineering	Hakeem Bailey	036300	(704)469 8463	hakeembaily@aerorag.com
Specialties-Staircase				()	
Structural				()	
Retaining Walls >5' High				()	
Other				()	

(*Owner should include firms and individuals such as town, precinct, pre-engineered, interior designers, etc.)

2018 NC BUILDING CODE: Select one

2018 NC EXISTING BUILDING CODE: Prescriptive N/A N/A
CONSTRUCTED: (date) 1998 CURRENT OCCUPANCY(S) (Ch. 3): Business
RENOVATED: (date) PROPOSED OCCUPANCY(S) (Ch. 3): Business
OCCUPANCY CATEGORY (Table 1804.5) Current: I Proposed: I

BASIC BUILDING DATA

Construction Type: IIA

Specklers: Yes NEPA 13

Standpipes: N/A

Primary Fire District: No

Flood Hazard Area: No

Special Inspections Required: No

Gross Building Area Table		
FLOOR	EXISTING (SQ.FT)	NEW (SQ.FT)
2 nd Floor	21,314	21,314
Mezzanine		
1 st Floor	21,314	21,314
Basement		
TOTAL	42,628	42,628

ALLOWABLE AREA (N/A - NO CHANGES)

Primary Occupancy Classification(s): Select one Select one Select one Select one Select one

Accessory Occupancy Classification(s):

Incidental Uses (Table 5.09):

Special Uses (Chapter 4 - List Code Sections):

Special Provisions (Chapter 5 - List Code Sections):

Net Occupancy: Select one Select one Select one Select one Select one

Select one Actual Area of Occupancy A + Actual Area of Occupancy B = 1

Allowable Area of Occupancy A + Allowable Area of Occupancy B = < 1.00

STORY NO.	DESCRIPTION AND SIZE	(A) BLDG AREA PER STORY (ACTUAL)	(B) TABLE 506.3 AREA	(C) AREA FOR FRONTAGE INCREASE ^{1,2}	(D) ALLOWABLE AREA PER STORY OR UNLIMITED ³

- ¹ Frontage area increases from Section 506.3 are calculated thus:
a. Perimeter which fronts a public way or open space having 20 feet minimum width = (P)
b. Total Building Perimeter = (P)
c. Ratio (PF) = (PF)
d. W = Minimum width of public way = (W)
e. Percent of frontage increase $\leq 100(P/P - 0.25) \leq W/30 =$ (%)
² Unlimited area applicable under conditions of Section 507.
³ Maximum Building Area = total number of stories in the building x D (maximum 3 stories) (506.2).
⁴ The maximum area of open parking garages must comply with Table 406.5.4
⁵ Frontage increase is based on the unspinklered area value in Table 506.2

ALLOWABLE HEIGHT (N/A- NO CHANGES)

	ALLOWABLE	SHOWN ON PLANS	CODE REFERENCE ¹
Building Height in Feet (Table 504.3) ²			
Building Height in Stories (Table 504.4) ²			

- ¹ Provide code reference if the "Shown on Plans" quantity is not based on Table 504.3 or 504.4
² The maximum height of air traffic control towers must comply with Table 412.3.1
³ The maximum height of open parking garages must comply with Table 406.5.4

FIRE PROTECTION REQUIREMENTS

BUILDING ELEMENT	FIRE SEPARATION DISTANCE (FEET)	REQ. FOR ENVELOPE	RATING (W/ MINIMUM R)	DETAIL # AND SHEET #	DESIGN # FOR RATED ASSEMBLY	SHEET # FOR RATED PENETRATIONS	SHEET # FOR RATED JOINTS
Structural Frame, including columns, girders, trusses		Exterior R					
Roofing/Walls							
Exterior	> 30	N/A					
Walls	> 30	N/A					
East	> 30	N/A					
West	> 30	N/A					
South	> 30	N/A					
North	> 30	N/A					
Retaining Walls and Partitions							
Exterior walls	> 30	N/A					
Walls	> 30	N/A					
East	> 30	N/A					
West	> 30	N/A					
South	> 30	N/A					
North	> 30	N/A					
Interior walls and partitions							
Fire Construction		N/A					
Including supporting beams and joists							
Fire Ceiling Assembly		N/A					
Column Supporting Beams		N/A					
Roof Construction, including supporting beams and joists		N/A					
Roof Ceiling Assembly		N/A					
Column Supporting Roof		N/A					
Shall Endowments - East		N/A					
Shall Endowments - Other		N/A					
Concrete Separation		N/A					
Concrete/Steel Beam Separation		N/A					
Partitions, Walls, Separators		N/A					
Single Glass Separators		N/A					
Double Glass Separators		N/A					
Fire-rated Glass Separators		N/A					
Fire-rated Glass Separators		N/A					

* Indicate protection assembly penetrating reduction

PERCENTAGE OF WALL OPENING CALCULATIONS

FIRE SEPARATION DISTANCE (FEET) FROM PROPERTY LINE	PERCENTAGE OF OPENINGS (TABLE 705.3)	ALLOWABLE AREA (%)	ACTUAL OPENINGS ON PLANS (%)

LIFE SAFETY SYSTEM REQUIREMENTS

Emergency Lighting: Select one
Exit Signs: Select one
Fire Alarm: Select one
Smoke Detection System: Select one
Carbon Monoxide Detection: Select one

LIFE SAFETY PLAN REQUIREMENTS (EXISTING - NO BUILDING CHANGES)

- Life Safety Plan Sheet #
- ☐ Fire and/or smoke rated wall locations (Chapter 7)
 - ☐ Assumed and real property line locations (if not on the site plan)
 - ☐ Exterior wall opening area with respect to distance to assumed property lines (705.3)
 - ☐ Occupancy Use for each area as it relates to occupant load calculation (Table 1004.1.2)
 - ☐ Occupant loads for each area
 - ☐ Exit access travel distances (1017)
 - ☐ Common path of travel distances (Tables 1006.2.1 & 1006.3.2(1))
 - ☐ Dead end lengths (1020.4)
 - ☐ Clear exit width for each exit door
 - ☐ Minimum calculated or stated load capacity each exit door can accommodate based on egress width (1005.5)
 - ☐ Actual occupant loads for each exit door
 - ☐ A separate schematic plan indicating where fire rated floor/ceiling and/or roof structure is provided for purposes of occupancy separation
 - ☐ Location of doors with panic hardware (1010.1.10)
 - ☐ Location of doors with delayed egress locks and the amount of delay (1010.1.9.7)
 - ☐ Location of doors with electromagnetic egress locks (1010.1.9.9)
 - ☐ Location of doors equipped with hold-open devices
 - ☐ Location of emergency escape windows (1030)
 - ☐ Net square footage of each fire area (202)
 - ☐ Net square footage of each smoke compartment for Occupancy Classification 1-2 (407.5)
 - ☐ Note any code exceptions or table notes that may have been utilized regarding the items above

ACCESSIBLE DWELLING UNITS (SECTION 1107)

TOTAL UNITS	ACCESSIBLE UNITS REQUIRED	ACCESSIBLE UNITS PROVIDED	TYPE A UNITS REQUIRED	TYPE A UNITS PROVIDED	TYPE B UNITS REQUIRED	TYPE B UNITS PROVIDED	TOTAL ACCESSIBLE UNITS PROVIDED

ACCESSIBLE PARKING (N/A - NO CHANGES) (SECTION 1106)

LOT OR PARKING AREA	TOTAL # OF PARKING SPACES		# OF ACCESSIBLE SPACES PROVIDED			TOTAL # ACCESSIBLE SPACES PROVIDED
	REQUIRED	PROVIDED	REGULAR WITH 5' ACCESSIBLE	132" ACCESSIBLE	5' ACCESSIBLE	
TOTAL						

PLUMBING FIXTURE REQUIREMENTS (N/A - NO CHANGES) (TABLE 2902.1)

SPACE	ENTRY	WATER CLOSURES		URINALS	LAVATORIES		SHOWERS / TUBS	DRINKING FOUNTAINS
		MALE	FEMALE		MALE	FEMALE		

SPECIAL APPROVALS

Special approval: Local Jurisdiction, Department of Insurance, OSC, DPI, DEHS, etc., describe below

ENERGY SUMMARY (N/A EXISTING - BLDG)

ENERGY REQUIREMENTS:
The following data shall be considered minimum and any special attribute required to meet the energy code shall also be provided. Each Designer shall furnish the required portions of the project information for the plan display. If performance in method, state the annual energy cost for the standard reference design vs annual energy cost for the proposed design.

Existing building envelope complies with code: Yes (The remainder of this section is not applicable)

Exempt Building: Select one Provide code or statutory reference

Climate Zone: 3A

Method of Compliance: Select one

(If "Other" specify source here)

THERMAL ENVELOPE (Prescriptive method only)

- Roof/Ceiling Assembly (each assembly)
Description of assembly:
U-Value of total assembly:
R-Value of insulation:
Sloped in each assembly:
U-Value of daylight:
total square footage of skylights in each assembly:
- Exterior Walls (each assembly)
Description of assembly:
U-Value of total assembly:
R-Value of insulation:
Openings (windows or doors with glazing)
U-Value of assembly:
Solar heat gain coefficient:
projection factor:
Door R-Value:
- Walls below grade (each assembly)
Description of assembly:
U-Value of total assembly:
R-Value of insulation:
- Floors over unconditioned space (each assembly)
Description of assembly:
U-Value of total assembly:
R-Value of insulation:
Horizontal/vertical requirement:
slab heated:
- Floors on grade (each assembly)
Description of assembly:
U-Value of total assembly:
R-Value of insulation:
Horizontal/vertical requirement:
slab heated:

2018 APPENDIX B
BUILDING CODE SUMMARY FOR ALL COMMERCIAL PROJECTS
STRUCTURAL DESIGN (N/A EXISTING - BLDG)
(PROVIDE ON THE STRUCTURAL SHEETS IF APPLICABLE)

DESIGN LOADS:

Importance Factors: Snow (G) Select one
Seismic (R) Select one

Live Loads: Roof psf
Mezzanine psf
Floor psf

Ground Snow Load: psf

Wind Load: Ultimate Wind Speed mph (ASCE-7)
Exposure Category Select one

SEISMIC DESIGN CATEGORY: Select one
Provide the following Seismic Design Parameters:
Risk Category (Table 1804.5) Select one
Spectral Response Acceleration %g %g %g
Site Classification (ASCE 7) Select one
Data Source Select one
Basic structural system Select one
Analysis Procedure Select one
Architectural, Mechanical, Components anchored? Select one

LATERAL DESIGN CONTROL: Select one

SOIL BEARING CAPACITIES: Select one
File type, type, and capacity psf

2018 APPENDIX B
BUILDING CODE SUMMARY FOR ALL COMMERCIAL PROJECTS
MECHANICAL DESIGN

MECHANICAL SUMMARY

MECHANICAL SYSTEMS, SERVICE SYSTEMS AND EQUIPMENT

Thermal Zone 18 F
winter dry bulb 31 F
summer dry bulb 79 F
winter dry bulb 79 F
summer dry bulb 79 F
relative humidity 50%

Building heating load: 650 MBH

Building cooling load: 164.9

Mechanical Spacing Conditioning System (see schedule)
Unitary
description of unit
heating efficiency
cooling efficiency
size category of unit

Boiler
Size category: If overhauled, state reason:
Chiller
Size category: If overhauled, state reason:

List equipment efficiencies:

2018 APPENDIX B
BUILDING CODE SUMMARY FOR ALL COMMERCIAL PROJECTS
ELECTRICAL DESIGN
(SEE ELECTRICAL SHEET 90.1)

ELECTRICAL SUMMARY

ELECTRICAL SYSTEM AND EQUIPMENT

Method of Compliance: Energy Code - Prescriptive

Lighting schedule (see schedule)
lamp type required in fixture
number of lamps in fixture
ballast type used in the fixture
number of ballasts in fixture
total wattage per fixture
total interior wattage specified vs. allowed (whole building or space by space)
total exterior wattage specified vs. allowed

Additional Efficiency Package Options
(When using the 2018 NCECC; not required for ASHRAE 90.1)
☐ C406.2 More Efficient HVAC Equipment Performance
☐ C406.3 Reduced Lighting Power Density
☐ C406.4 Enhanced Digital Lighting Controls
☐ C406.5 On-Site Renewable Energy
☐ C406.6 Dedicated Outdoor Air System
☐ C406.7 Reduced Energy Use in Service Water Heating

AeroRaq Engineering Inc
Engineering Services
8511 Davis Lake Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/2025

Revisions

No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT
Project No: 01-2025015

Scale: N/A

Date: 09-16-2025

Title: Appendix B

G0.2

Dedicated Outside Air Unit Schedule																				
Plan ID	Service Area	Manufacturer or Equal	Model #	Fan Data							Dx Cooling Coil Data					Electrical		Weight	Accessories	Comments
				Fan Type	Fan Hp	Supply CFM	ESP (in w.c.)	Return CFM	Min. O.A.	Max. O.A.	Entering Air Temp. (dbF/wb F)	Total Cooling Capacity (MBH)	Sensible Cooling Capacity (MBH)	Leaving Air Temp. (dbF/wb F)	Branch Pipe Size & Schedule	Unit Voltage	MCA			
MU-1	Paksoy Bldg	Aaon	H3-DLB-3-0-462C	Cent	6	6300	1.5	0	6000	6000	88.1/ 72.4	305	187	54/ 53	1.38" & .63"	460/ 3	8	750	1, 2, 3, 4	1, 2, 3, 4, 5

Accessories:

- Factory provided air filter slot w/ 2" MERV 8 filter
- Factory installed DDC Compatible Controls: Modbus, BACnet MS/TP, BACnet IP capable communication
- Hot Gas Reheat, Dehumidification cycle
- Freeze Protection

Comments:

- Install unit using the factory recommended specifications
- Refrigerant is 454B
- Left Hand oriented unit top discharge
- Vibration isolators for frame on top of expanded concrete pad
- Equivalent manufacturers are Aaon, SpartanAire Custom DX and LG

Condenser Unit Schedule													
Plan ID	Service Area	Manufacturer or Equal	Model #	Total Cooling Cap. (MBH)	Sens. Cooling Cap. (MBH)	EER	Volts/Phase	Max Fuse Size	MCA	Size	Weight	Accessories	Comments
CU-1	Paksoy Bldg	Aaon	CFA-030-C-A-3-LA00N	305	187	10.5	460/ 3	70	52	63" x 91" x 68"	1542	1, 2	1, 2, 3

Accessories:

- Hot Gas Reheat, Dehumidification cycle
- Freeze Protection

Comments:

- Install unit using the factory recommended specifications
- Refrigerant is 454B
- Equivalent manufacturers are Aaon, SpartanAire Custom DX and LG

Packaged RTU Unit Schedule (DX Cooling & Nat. Gas Fired)																			
Plan ID	Service Area	Manufacturer or Equal	Model #	Supply CFM	O.A. CFM	ESP (in w.c.)	Min. Heating Capacity (BTU/hr)	Total Cooling Cap. (BTU/hr)	Sens. Cooling Cap. (BTU/hr)	SEER	AFUE	Motor Hp.	Volts/ Phase	MOCP	MCA	Size	Weight	Accessories	Comments
RTU-1	Field House (Locker Rooms)	TempMaster	KYG04E2B1AA5H32A1	1200	310	0.7	58000	37100	26200	15	81%	1.5	208V /3ø	30	26.1	49" x 74" x 40"	600	1, 2, 3, 4, 5, 6, 7, 8, 9	1, 2, 3, 4
RTU-2	Field House (Concessions/Class)	TempMaster	KYG04E2B1AA5H32A1	1200	310	0.7	58000	37100	26200	15	81%	1.5	208V /3ø	30	26.1	49" x 74" x 40"	600	1, 2, 3, 4, 5, 6, 7, 8, 9	1, 2, 3, 4

Accessories:

- Factory provided air filter slot w/ 2" MERV 13 filter
- Hail Guard
- Powered GFI Outlet
- Low Ambient Controls
- Two stage cooling modes
- Downflow economizer w/ single enthalpy sensor
- 7 day programmable thermostat
- Factory disconnect switch
- Condensate overflow switch

Comments:

- Install unit using the factory recommended specifications
- Field install economizer hood
- Curb adapters
- Refrigerant is 454B
- Equivalent manufacturers are Carrier, Trane and Tempmaster

Air Distribution Device Schedule										
Plan ID	Service	Manufacturer	Model #	Type	CFM Range	Panel Size	Neck Size	Finish	Accessories	Comments
A	Supply	Price	SCD	Square Diffuser	100 - 225	24" x 24"	0'-8"	White	1	

Accessories:

- Install balancing damper

Comments:

- N/A

Alternate 1:

Unit Heater Schedule									
Plan ID	Service	Manufacturer	Model #	Fuel	Btuh Input	Btuh Output	Voltage/ Amps	Weight (lbs)	Contoller
H-1	Patio	Sunpak	S34 S- SS	Nat. Gas	34,000	27,200	115, 1ø / 1A	55	Switch
									1, 2, 3, 4, 5

Comments:

- Install at 12" - 6" AFF. 30" Downward Angle
- Install using manufacturers instructions
- 120V to 24V transformer for controller. NEMA 3R rated
- Minimum gas pressure 6" w.c., max pressure 1/2 psi
- Equivalent manufacturers are SunPak, Infratech & Sunstar

GAS PIPING NOTES	
1. Minimum gas piping size shall be 1/2"	
2. Gas piping shall be installed to the requirements of the North Carolina fuel gas code and NFPA Standard No. 54. All inside piping to be supported by devis hangers with galvanized rod with a maximum of 8' on center.	
3. Gas piping shall be tested in accordance with the procedures noted in NFPA Standard No. 54. All tests required by the local gas inspection department or gas company shall also be provided.	
4. Paint all gas piping with two coats of yellow enamel and stencil "Gas" on pipe at 5'-0" centers.	
5. Gas valves shall be a min. 125 psi rated, non-lubricated plug type with bronze body and bronze plug.	
6. Provide unions, flanges, coupling and fittings at connection to all valves and equipment. Do not use direct welded or threaded connection to valves or equipment.	
7. Provide non-conducting dielectric unions whenever connecting dissimilar metals.	
8. Gas piping routed on the roof shall have pipe supported provided in accordance with the 2018 NC Fuel Gas Code chapter 4	

Gas Load Requirements, Meter no. 727590				
Item	Description	Qty	Input MBH	Total MBH
RTU 1	Replaced Rooftop Package Unit	1	112	112
RTU 2	Replaced Rooftop Package Unit	1	112	112
H1	New Patio Heater	2	34	68
WH-1	Existing Hot Water Heater	1	119	119
TOTAL BUILDING LOAD MBH		=	411	

GAS PIPE SIZING CALCULATIONS	
■ NCGFC Table 402.4(5) - 2.0 PSIG W/1.0 PSIG pressure drop	
■ Total Gas Input (new equipment): 792	
■ High Pressure: P1=2.0 PSIG P2=1.0 PSIG	
■ Length: 79'-0" LN/FT	
■ Fittings Factor: 1.25 (25%)	
■ Total Equivalent Length of 99 ft	
■ Natural Gas Steel: Schedule 40 Metallic Pipe	

General Installation Requirements

- Drawings are diagrammatic and are intended to convey scope and general arrangements unless otherwise indicated. They do not show every rise, fitting, offset and detail. It is the contractor's responsibility to read and understand the scope and intent of the drawings and specifications and deliver a complete and operational system that performs to the specifications and documents provided.
- All mechanical permits and inspection fees shall be obtained and paid by the mechanical contractor.
- Contractor is responsible for materials and installing the work in accordance with all applicable local, state and national codes.
- Do not scale drawing for measurements.
- It is the contractor's responsibility to verify duct and pipe paths are free of obstruction and reroute as necessary should an obstruction occur.
- It is the contractor's responsibility to coordinate with the gas and power company to arrange and facilitate shutdown of utilities as necessary to integrate new system.
- It is the contractor responsibility to survey existing conditions and make adjustments to duct size, route and configurations to deliver the required air to the system zones.
- Install all equipment using the manufacturer's recommended installation procedures.
- It is the contractor's responsibility to notify and coordinate with building owner when work will cause any interruption in services to building whether utilities, path obstruction, etc..
- The contractor will provide protection of materials, tools and equipment during the construction phase including protective covers, skids, plugs, caps, boxes and temporary fences.
- All equipment shall be U.L. Listed.
- All cutting and patching of walls and floors for mechanical equipment shall be the responsibility of the mechanical contractor.

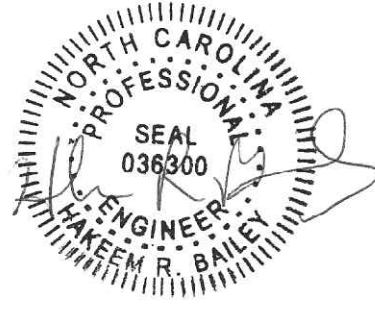
Mechanical Installation Requirements

- Furnish all labor, material and equipment required for the complete installation and operation of all systems in this section of work in accordance with recommended practice and all applicable codes.
- Mechanical contractor shall guarantee all work and materials for one year, effective the day the project is accepted by the owner. Refrigerant compressors shall be guaranteed for five years.
- Seal the joints airtight between package units and supply ducts. Seal joints above the roof and not transversing through the target spaces.
- Airtight seals shall be field applied mastic complying with UL 181 A-M or mastic tape complying with UL 181 A-P
- Provide and install permanent tags in a location that is readily visible on all installed equipment that includes all pertinent operating information including; make, model no., capacity, voltage, ampacity, heating data, cooling data. See specs for details.
- Contractor will locate equipment as such so that maintenance personnel will have access to panels, control boards and valves.
- Contractor will perform a test and balance of the system in accordance with the 2018 NCECC section 503.2.9. Test shall result in +5% to -.5% of design flow.
- Contractor will follow the latest SMANCA HVAC Duct Construction Standards for duct sheet thickness and fastening methods.
- All control wire shall be provided by Mechanical Contractor.
- Support the duct routes with a maximum of 10' between centerline of supports.
- All equipment supports are required to meet ASCE 9.6

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone: 704 469 8463

Note:

This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/2025

Revisions

No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT

Project No:
01-2025015

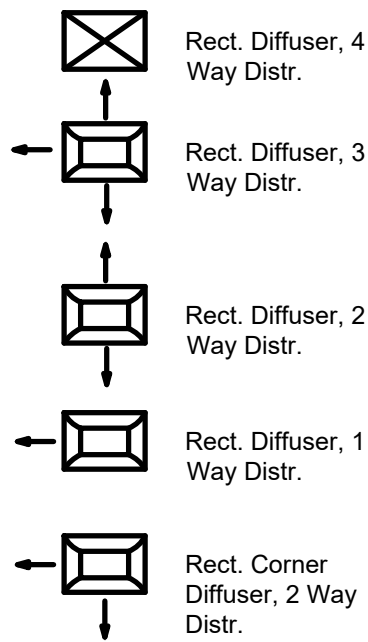
Scale: N/A

Date: 09-16-2025

Title: Mechanical
Schedules

M0.1

Legends, Symbols & Icons



Rect. Diffuser, 4 Way Distr.



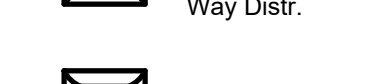
Rect. Diffuser, 3 Way Distr.



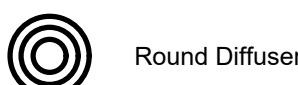
Rect. Diffuser, 2 Way Distr.



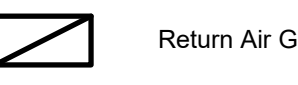
Rect. Diffuser, 1 Way Distr.



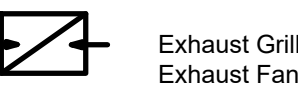
Rect. Corner Diffuser, 2 Way Distr.



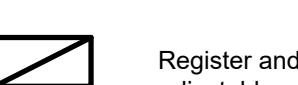
Round Diffuser



Return Air Grille



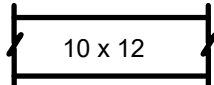
Exhaust Grille or Exhaust Fan



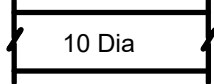
Register and Grille, adjustable



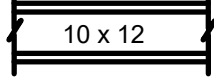
Register, Diffuser & Grille, Call out



10 x 12 Rect. Rigid Duct



10 Dia Round Rigid Duct



10 x 12 Lined Rect. Rigid Duct



Rigid Duct Transition



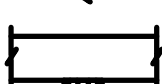
Flexible Duct



Vertical Duct Conn. Normal to viewing plane



Stand. Rect. Take-off w. Vol. Damper



Rect. to Round Take-off



Round. to Round Take-off



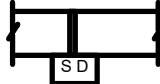
90 deg. Turn Elbow w. Turning Vanes



Smooth Turn Elbow Radius = 1.5 Duct Depth



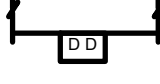
Manual Damper



Smoke Damper



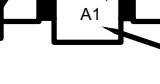
Fire Damper



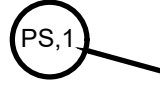
Duct Smoke Detector



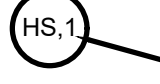
Duct Heater



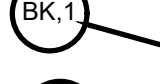
Variable Air Volume Box, Static or Fan



Pressure Sensor Spec. Type



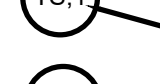
Humidity Sensor Spec. Type



Boiler Kill Switch Spec. Type



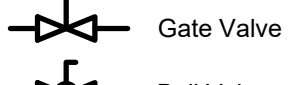
Thermostat Spec. Type



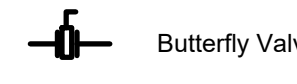
Temperature Sensor Spec. Type



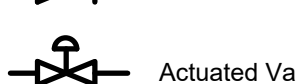
Flow Switch Spec. Type



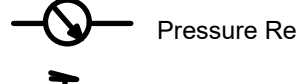
Gate Valve



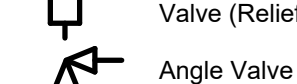
Ball Valve



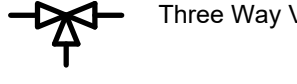
Butterfly Valve



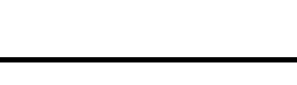
Check Valve



Actuated Valve



Pressure Reducer

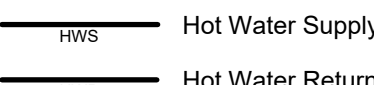


Pressure Safety Valve (Relief)



Angle Valve

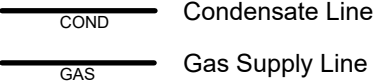
Three Way Valve



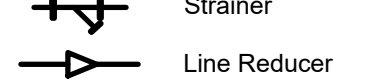
Hot Water Supply



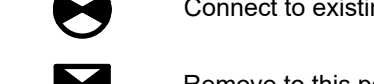
Hot Water Return



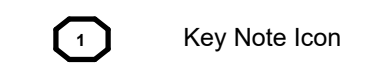
Chilled Water Supply



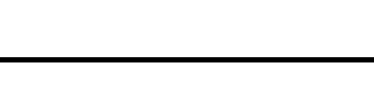
Chilled Water Return



Condensate Line



Gas Supply Line



Strainer

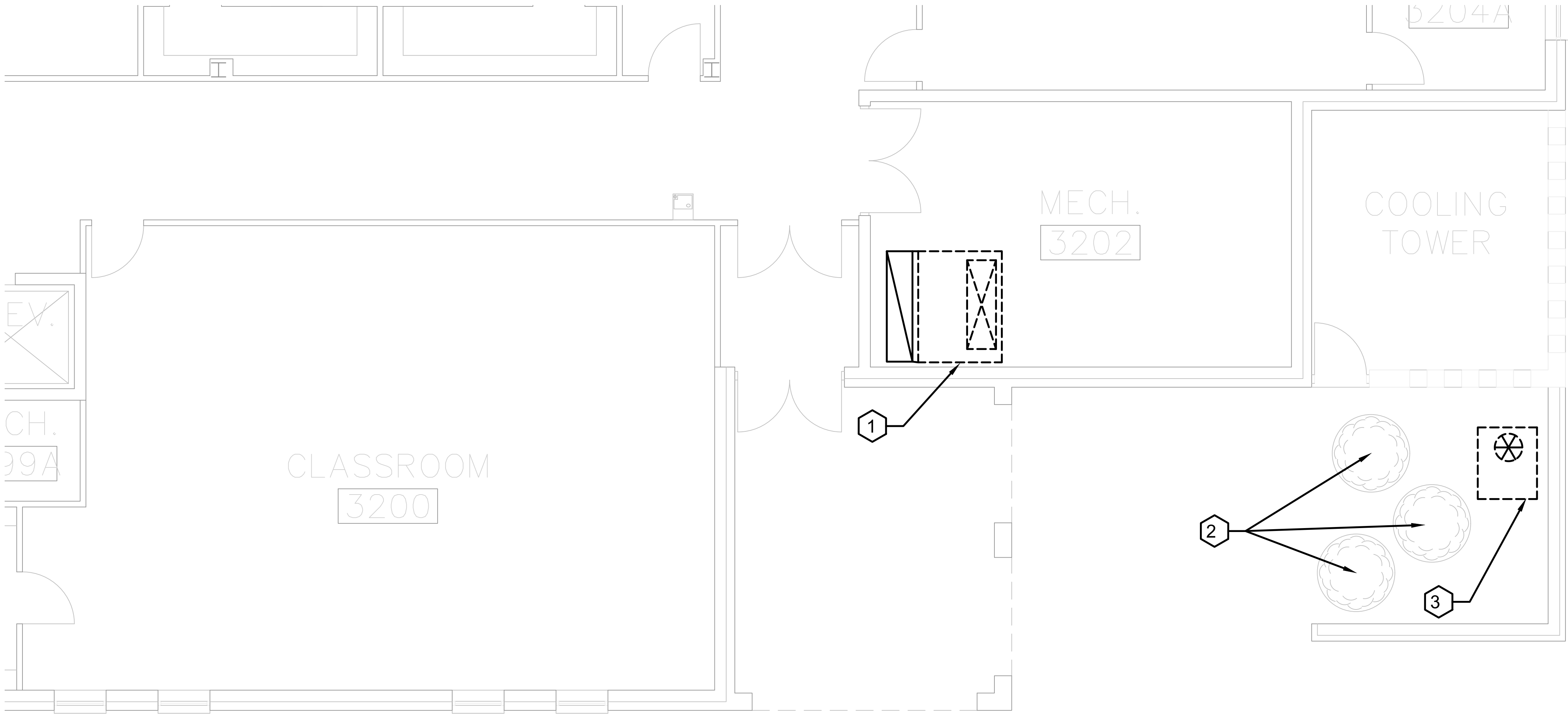


Line Reducer

Connect to existing at this point

Remove to this point

Key Note Icon

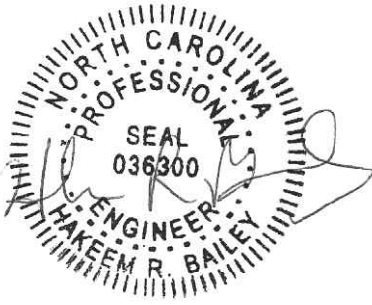


Notes Keyed to Plan:

1. Demolish and properly dispose of existing MU-1 and support pad.
2. Excavate and remove shrubs. Refill dirt and compact to 98% on the proctor scale.
3. Demolish and properly dispose of existing condensing unit and support pad. Remove refrigerant lines back to air handler.

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/2025

Revisions

No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT

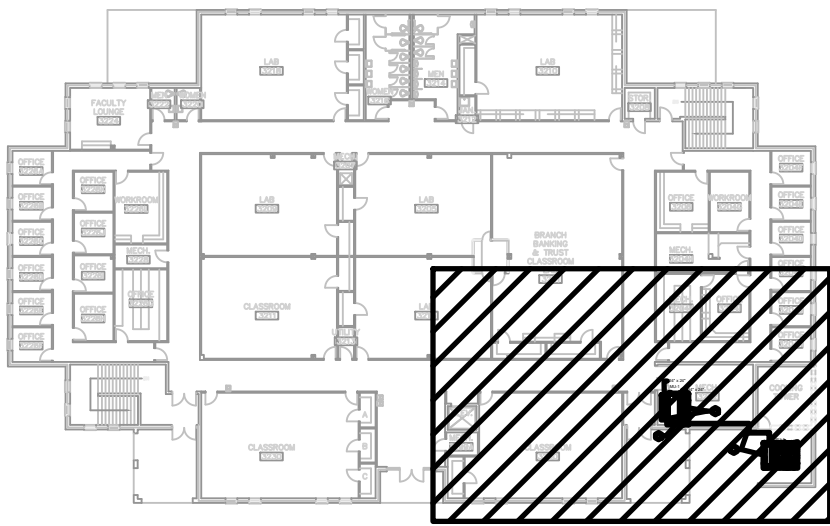
Project No:
01-2025015

Scale: $\frac{1}{4}" = 1' 0"$

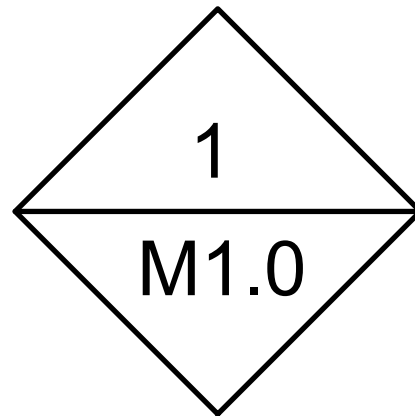
Date: 09-06-2025

Title: Mechanical Demo Plan

M1.0

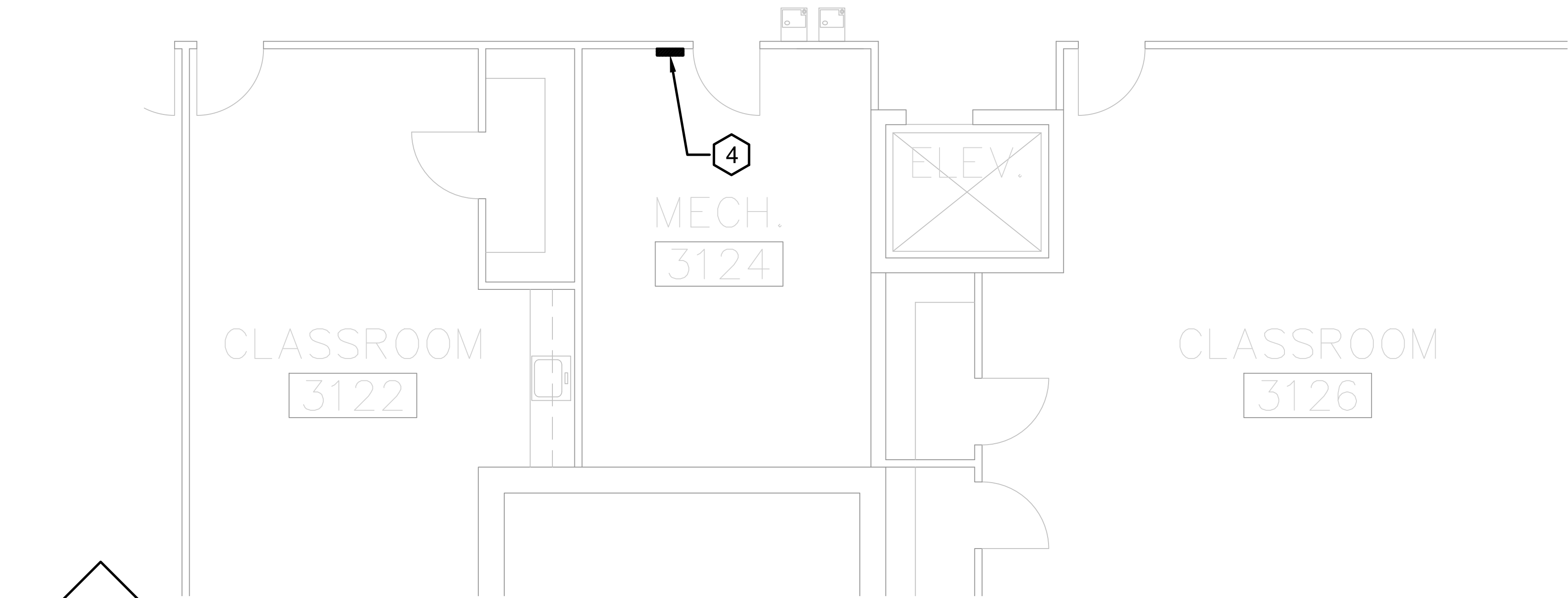


Key Plan



Mechanical Demo Plan - 2nd Floor Paksoy Bldg

Scale: $\frac{1}{4}" = 1' - 0"$



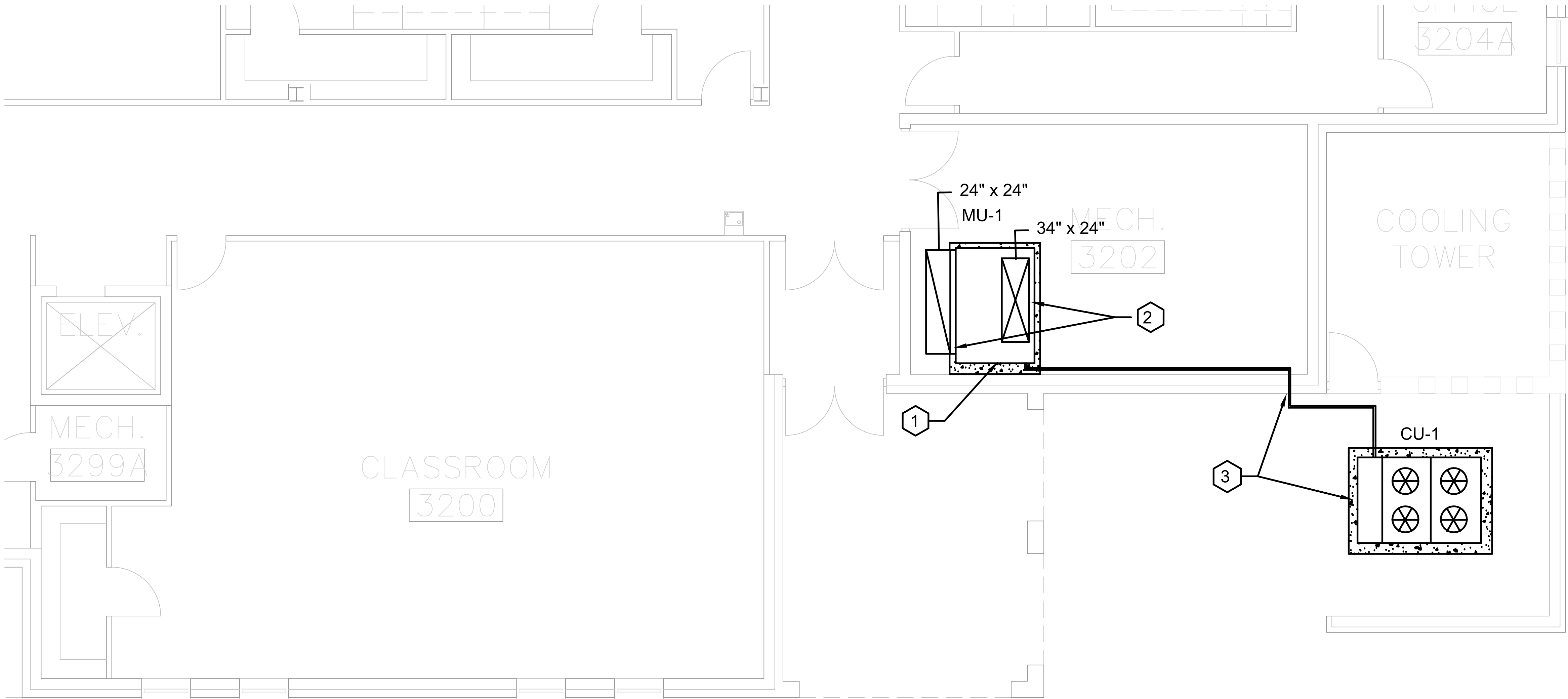
- Notes Keyed to Plan:**
- 1. Pour new 6' x 8' concrete support pad. Support unit with vibration isolators.
 - 2. Modify ductwork to connect to new MU-1. Flexible connections are required at the connection points.
 - 3. Place condensing unit outside at mezzanine enclosed area on new 7' x 9' concrete pad . Route refrigerant lines thru building using existing wall penetration. Seal penetrations.
 - 4. Unit will be controlled thru BAS JACE on the first floor. Controls contractor to add points and graphics to front end, see sheet M3.1 for details. The current JACE is a building logix controller, with open ended software.

1

M1.1

Mechanical Plan - 1st Floor Paksoy Bldg

Scale: 1/4" = 1' - 0"

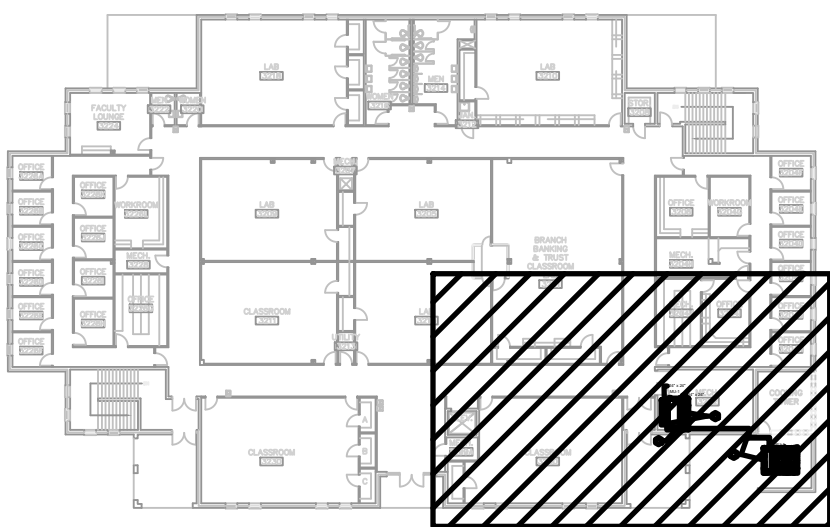


1

M1.1

Mechanical Plan - 2nd Floor Paksoy Bldg

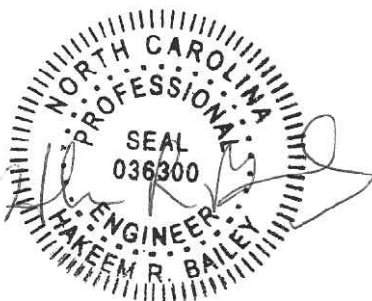
Scale: 1/4" = 1' - 0"



Key Plan

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/2025

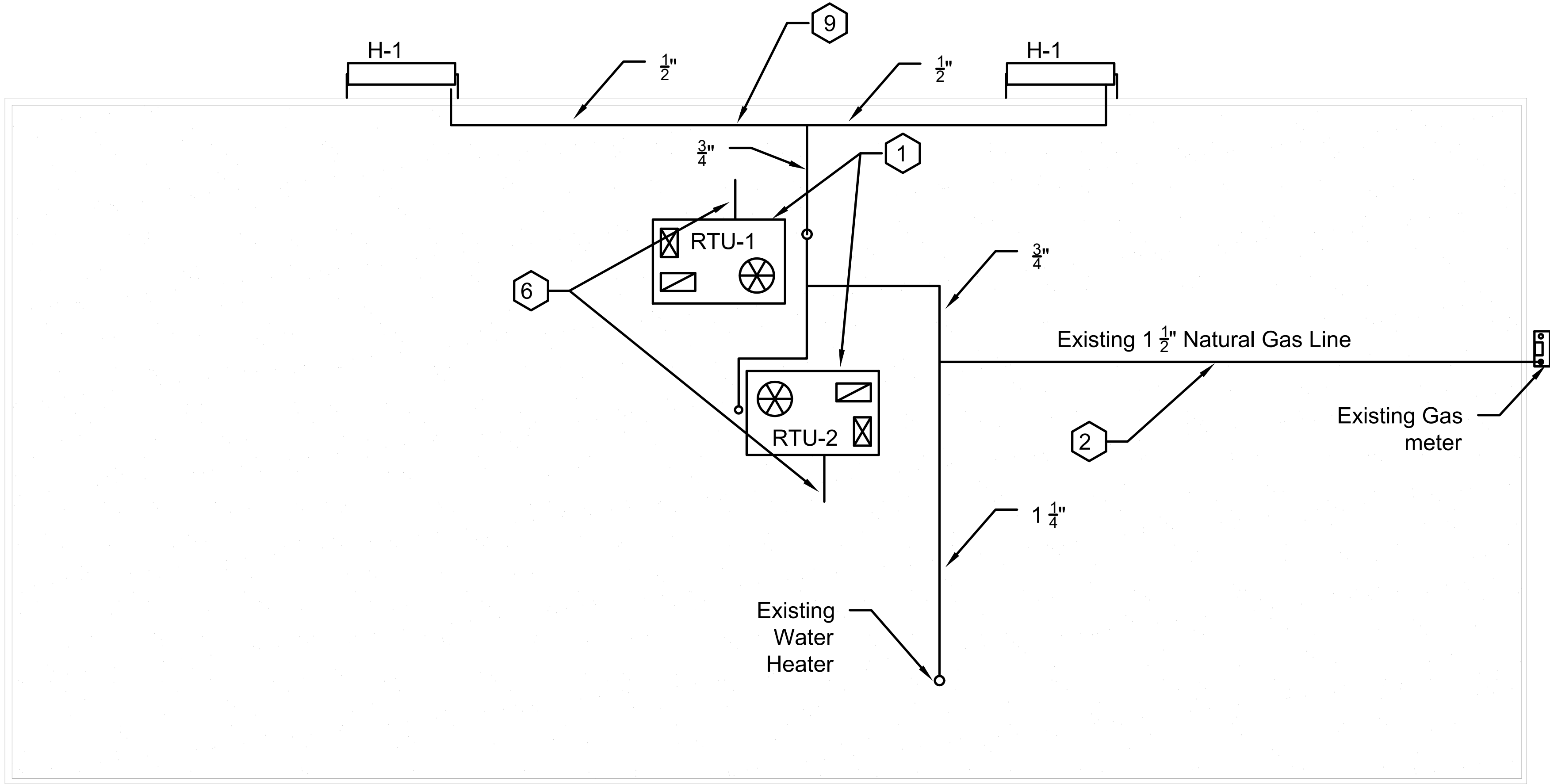
Revisions

No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

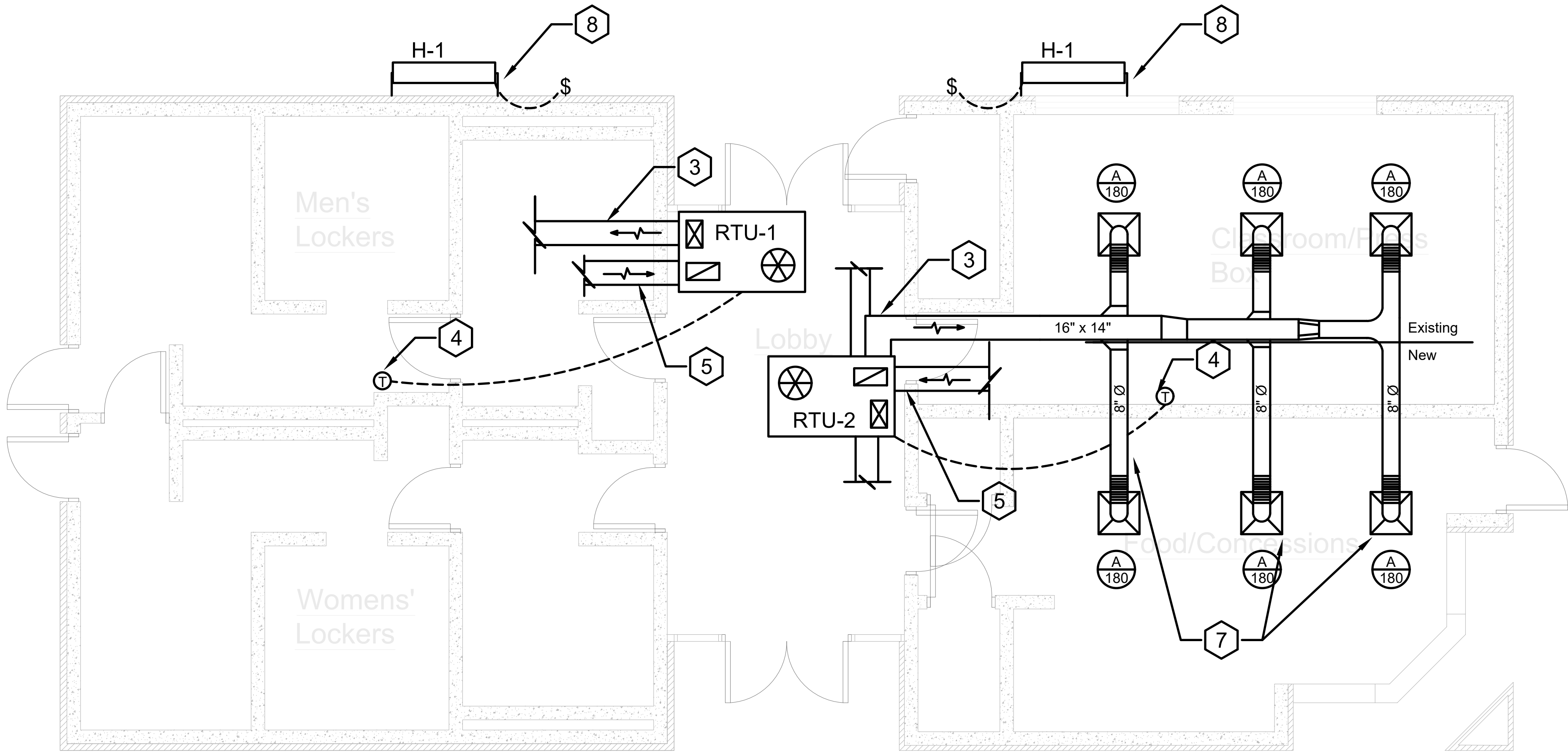
COPYRIGHT
Project No: 01-2025015
Scale: 1/4" = 1' - 0"
Date: 09-16-2025
Title: Mechanical Plan
- Paksoy Bldg

M1.1



- Notes Keyed to Plan:**
1. Demo existing RTUs and replace with new RTUs. Use curb adapters to fasten new units to the roof.
 2. Route existing gas line to new units. Install regulators as necessary to supply RTU furnaces.
 3. Adjust existing duct work as necessary to connect to the new RTUs.
 4. Demo and replace unit controlling thermostat with new Wi-Fi enabled, 7 day programmable t'stat. Honeywell RTH9585WF1004 or equivalent. Patch, paint and repair location where t'stat has been removed.
 5. Reinsulate any removed insulation from adjusted ductwork.
 6. Route condensate lines to roof drains.
 7. Add ductwork and diffusers to add cooling to the concession area. Rebalance air flow to noted CFM. Repair gupsum ceiling after installation. Route around existing above ceiling ductwork.
 8. ALTERNATE1: Install two patio style unit heaters at 12'-6" above grade.
 9. ALTERNATE1: Route gas line to new unit heaters. Install pressure regulators as required.

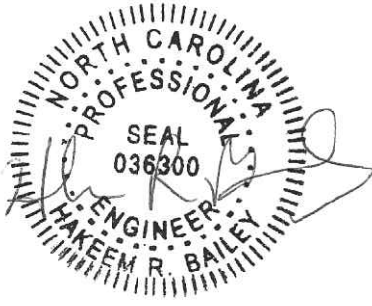
1
M1.2
Mechanical Roof Plan - Field House
Scale: 1/4" = 1' - 0"



1
M1.2
Mechanical Plan - Field House
Scale: 1/4" = 1' - 0"

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/2025

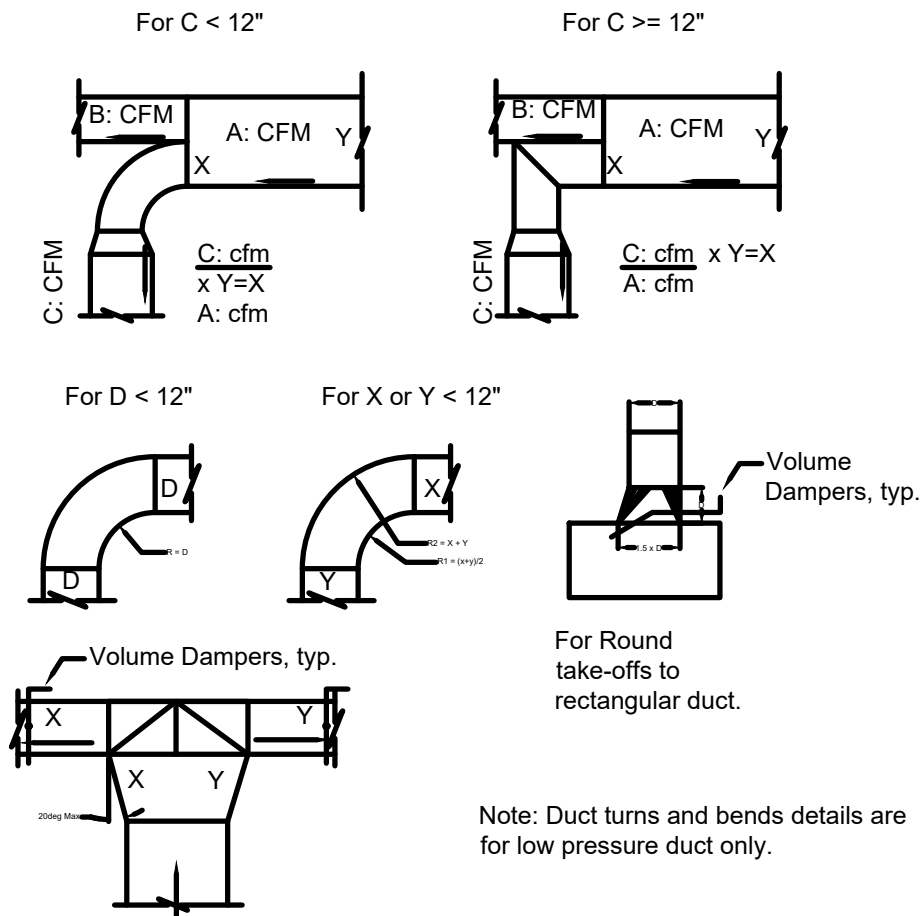
Revisions

No.	Date

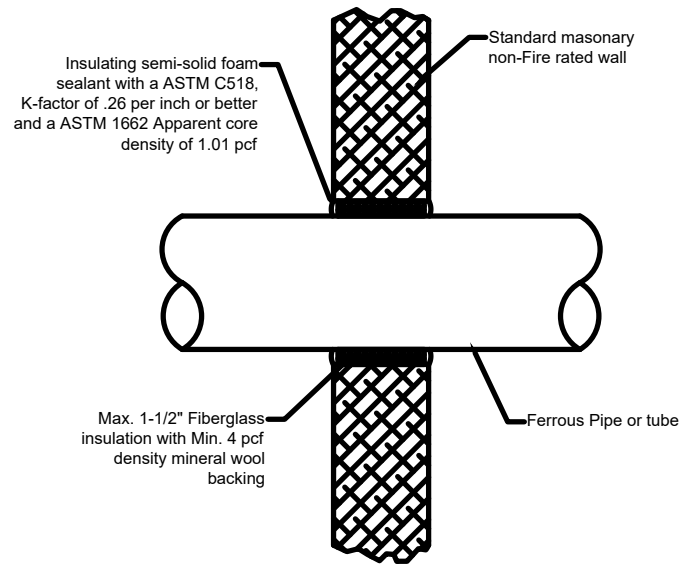
Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT
Project No: 01-2025015
Scale: 1/4" = 1' - 0"
Date: 09-16-2025
Title: Mechanical Plan - Field House

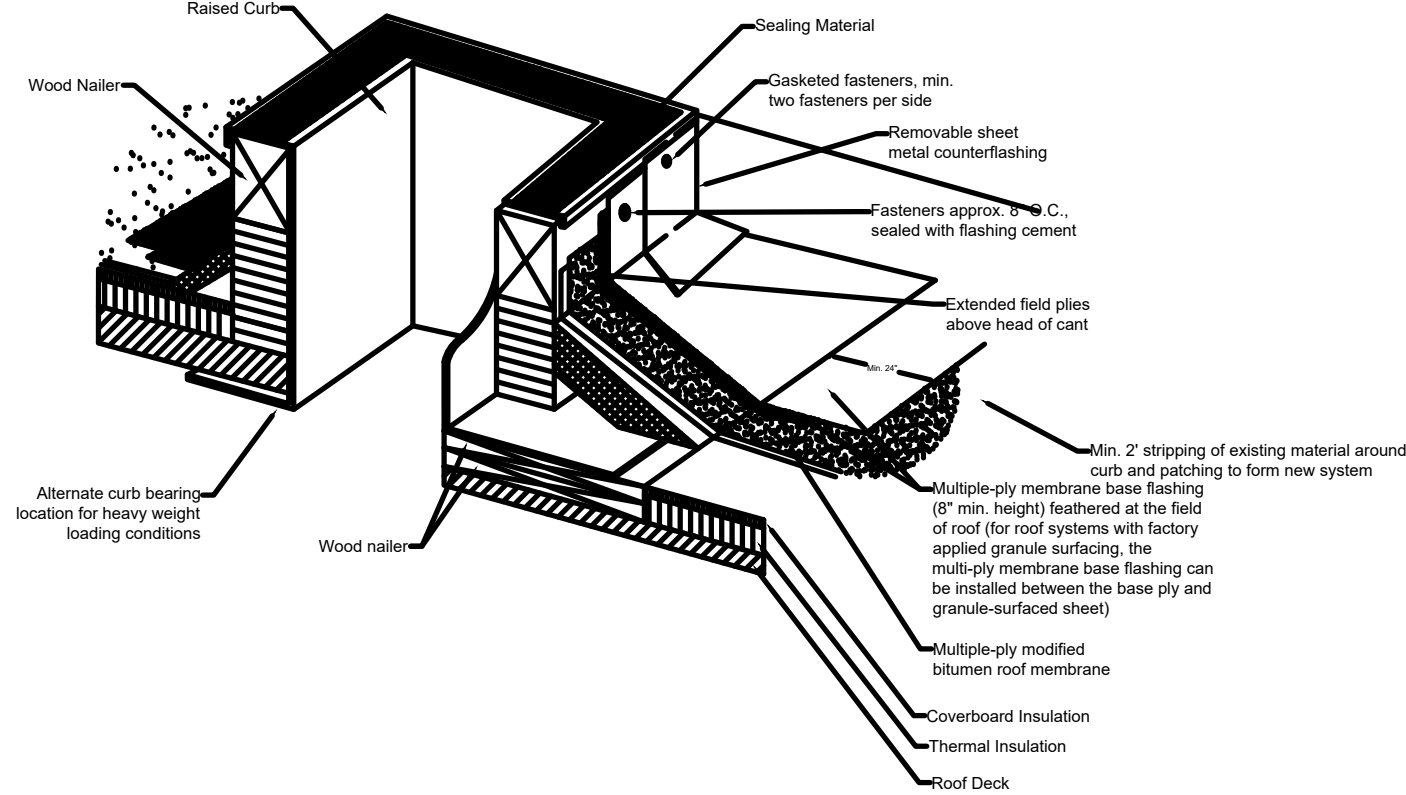
M1.2



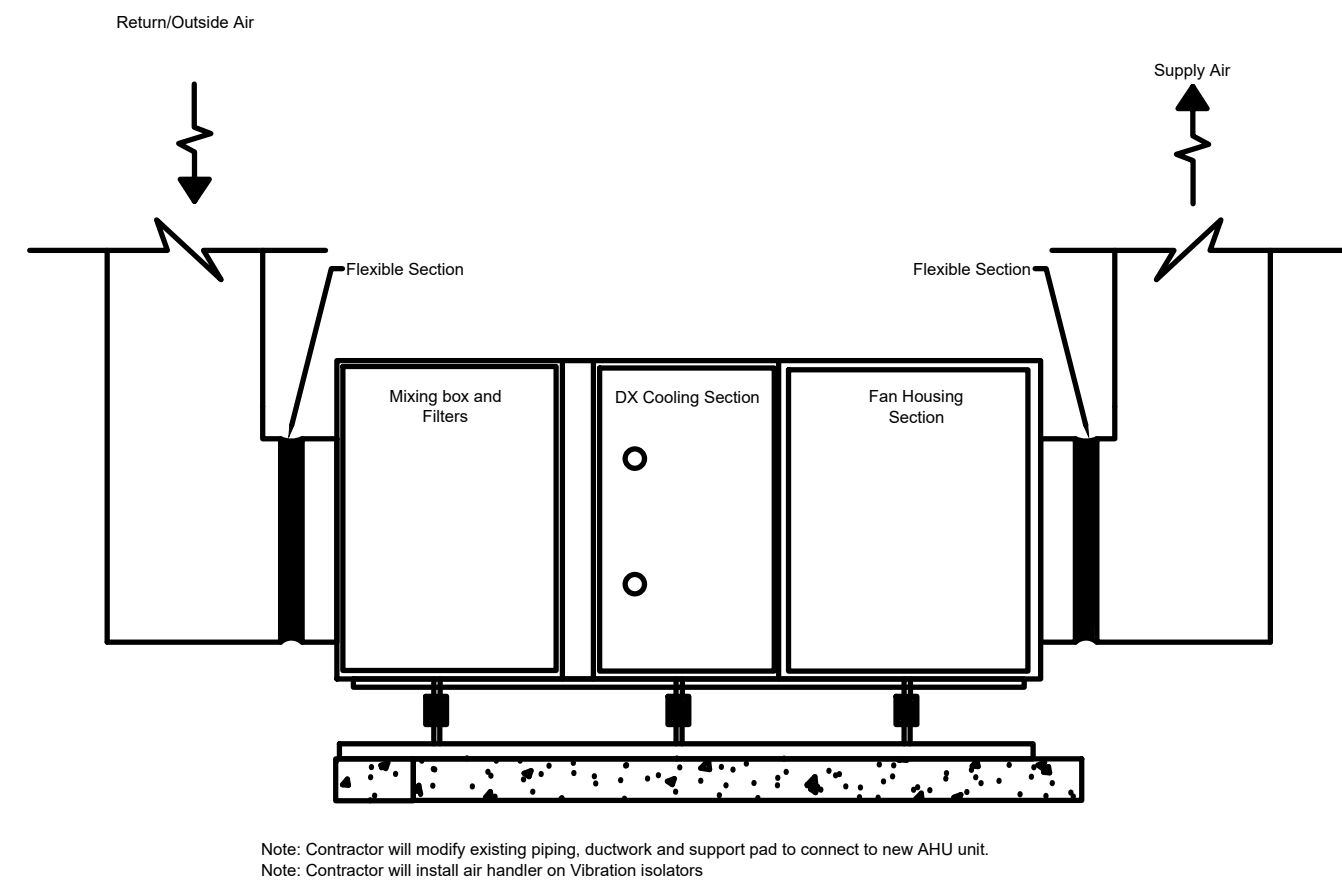
1 Duct Turns and Bends
Scale: N/A



2 Pipe penetration of wall
Scale: N/A



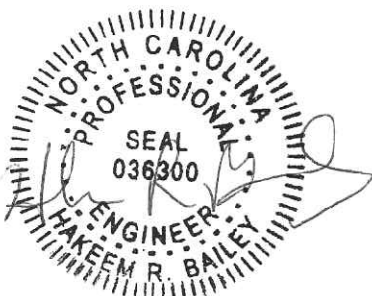
3 Roof Curb Flashing
Scale: N/A



4 Air handler detail
Scale: N/A

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/2025

Revisions

No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT

Project No:
01-2025015

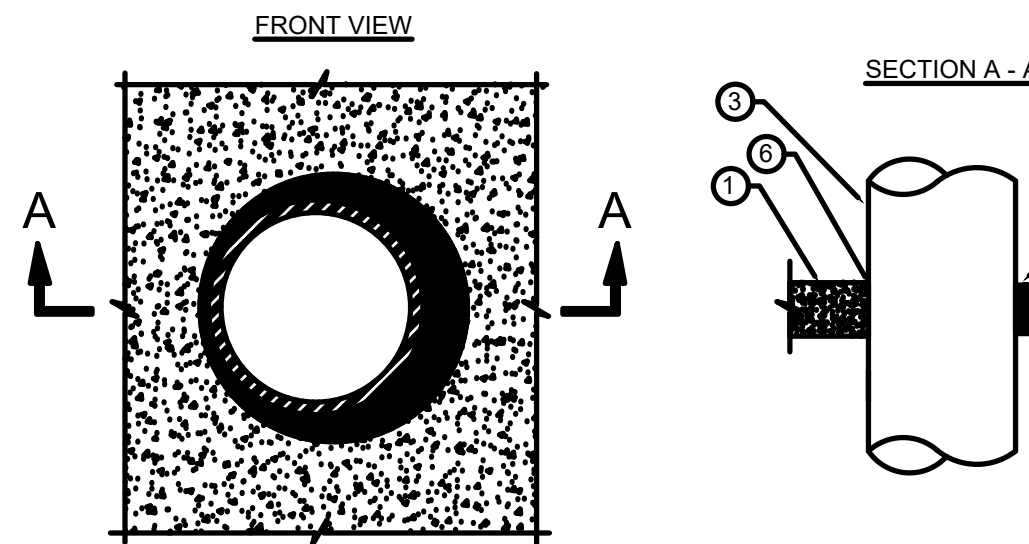
Scale: N/A

Date: 09-16-2025

Title: Mechanical Details

M2.1

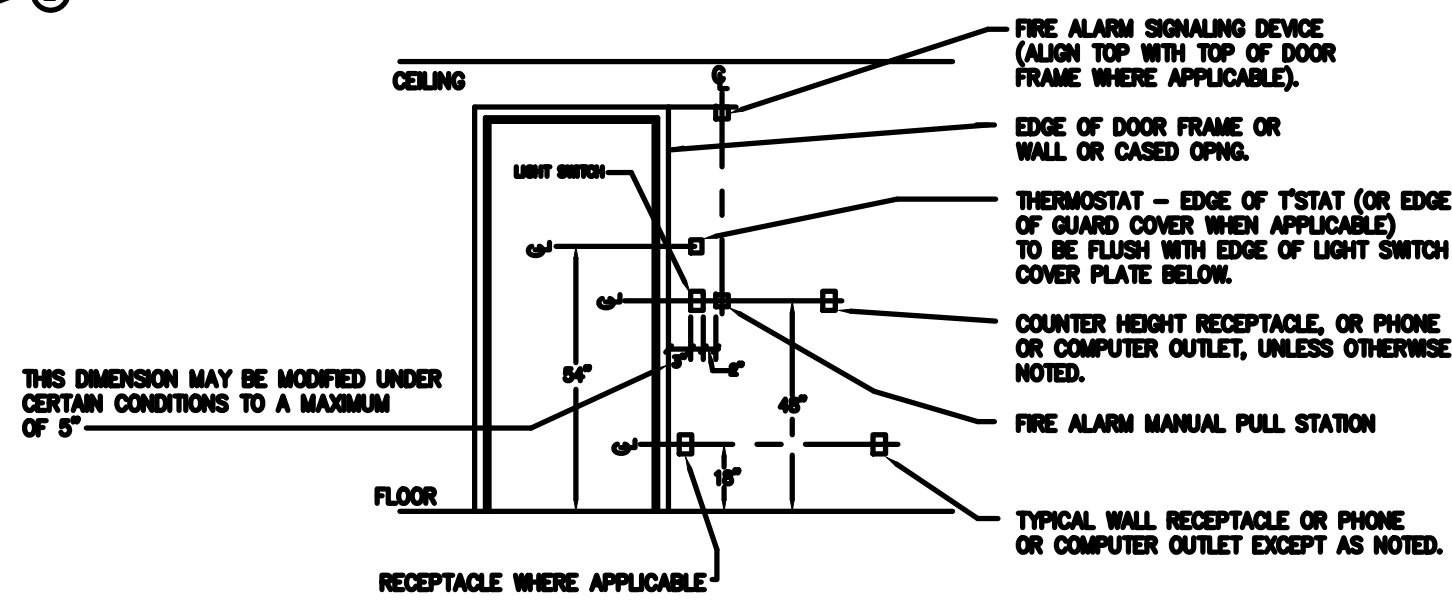
UL/cUL SYSTEM No. CAJ5001
METAL PIPE THROUGH A SLEEVE IN CONCRETE FLOOR/WALL OR BLOCK WALL
F RATING = 1 1/2 HR
T RATING = 15 MIN
L RATING AT AMBIENT = LESS THAN 1 CFM/SQ. FT.
L RATING AT 400° F = 4 CFM/SQ. FT.



1. CONCRETE FLOOR OR BLOCK ASSEMBLY (1 1/2 HR FIRE RATING);
- 1.1. LIGHTWEIGHT OR NORMAL WEIGHT CONCRETE FLOOR OR WALL (MIN. 2-1/2" THICK);
- 1.2. ANY ULULC CLASSIFIED CONCRETE BLOCK WALL;
2. OPTIONAL MAXIMUM 12" NOMINAL DIAMETER STEEL PIPE SLEEVE (SCH. 40 OR HEAVIER);
3. PENETRATING ITEM TO BE ONE OF THE FOLLOWING:
 - 3.1. MAX. 12" NOMINAL DIAMETER STEEL PIPE (SCH. 10 OR HEAVIER);
 - 3.2. MAX. 12" NOMINAL DIAMETER CAST IRON PIPE;
 - 3.3. MAX. 8" NOMINAL DIAMETER COPPER PIPE;
 - 3.4. MAX. 8" NOMINAL DIAMETER STEEL CONDUIT;
 - 3.5. MAX. 4" NOMINAL DIAMETER EMT;
4. MINIMUM 2" THICKNESS MINERAL WOOL (MIN. 4 PCF DENSITY) TIGHTLY PACKED;
5. MINIMUM 1/2" DEPTH HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT;
6. MINIMUM 1/2" CROWN HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT APPLIED AT POINT OF CONTACT.

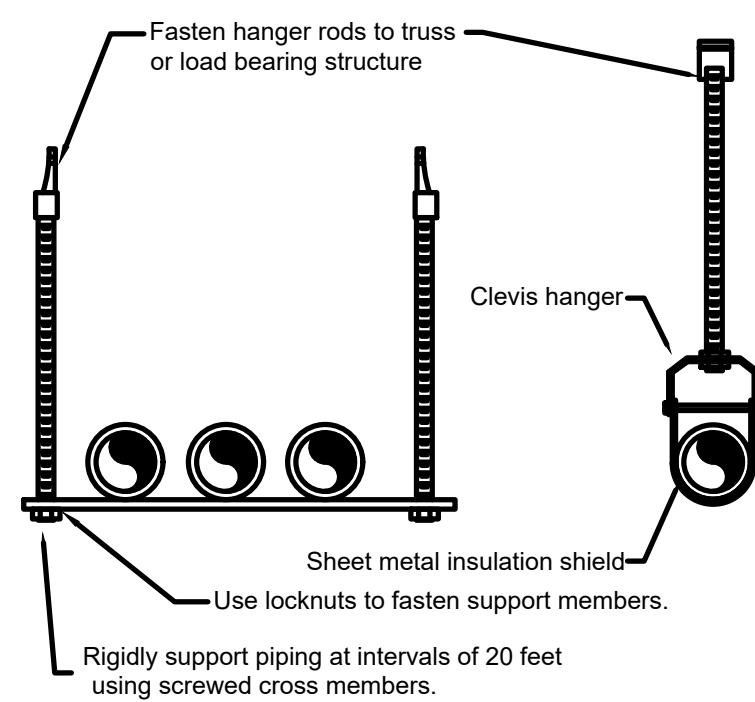
NOTES:
1. MAXIMUM DIAMETER OF OPENING = 12"
2. ANGULAR SPACE = MINIMUM 0" MAXIMUM 1-1/2"
3. MINIMUM 1/2" DEPTH HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT IS REQUIRED ON BOTH SIDE OF A WALL ASSEMBLY.

5 Fire rated pipe penetration
Scale: N/A

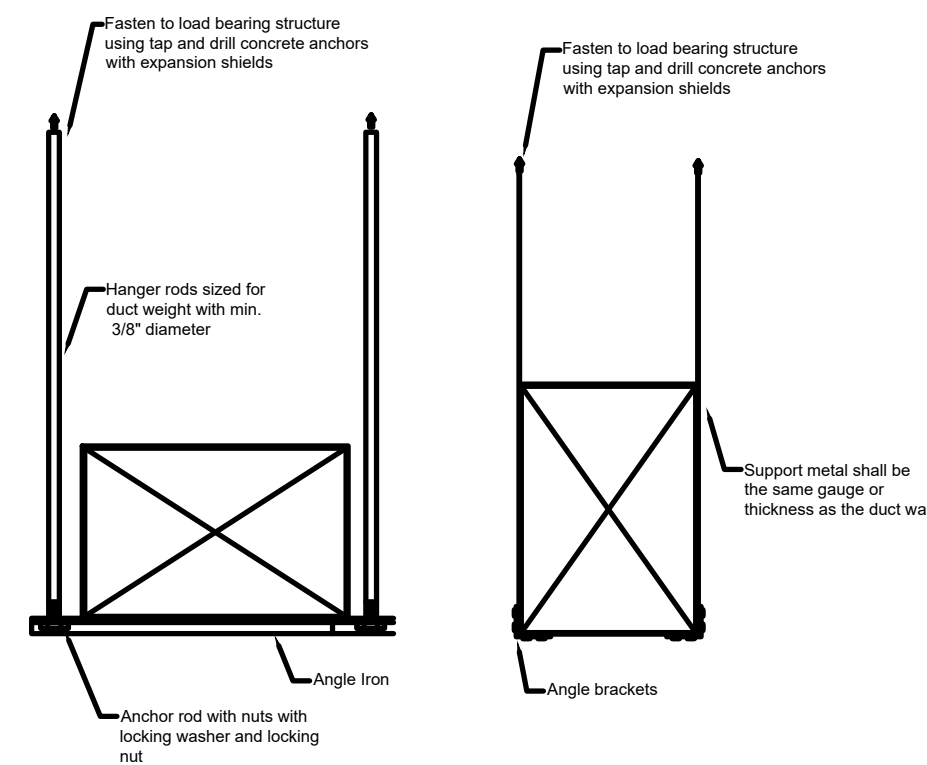


NOTE:
ALL THERMOSTATS, SWITCHES, AND OTHER DEVICES SHALL BE INSTALLED IN A NEAT AND ORDERLY FASHION, WITH EACH ITEM BEING FLUSH & SQUARE.

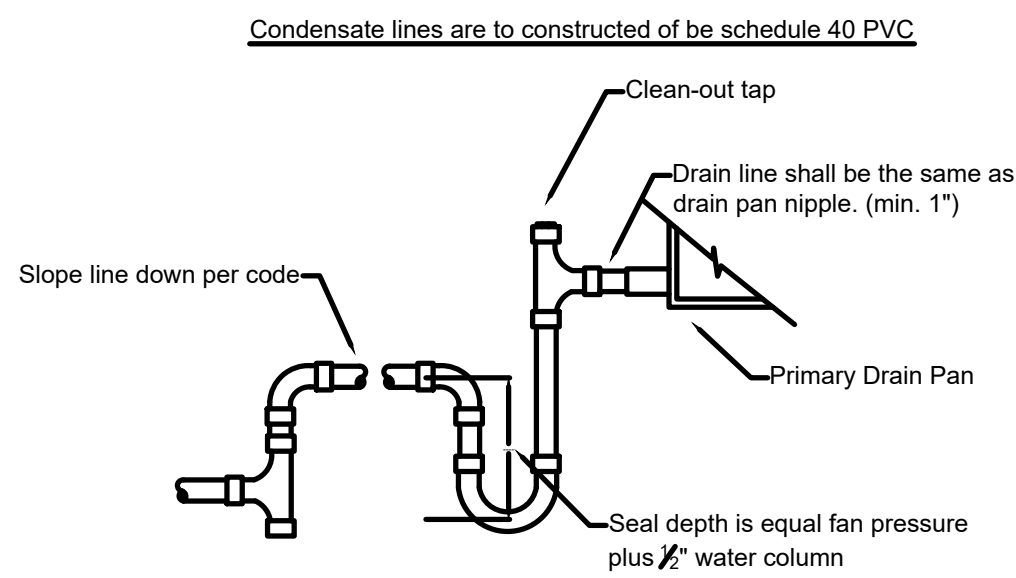
6 Height of Switches
Scale: N/A



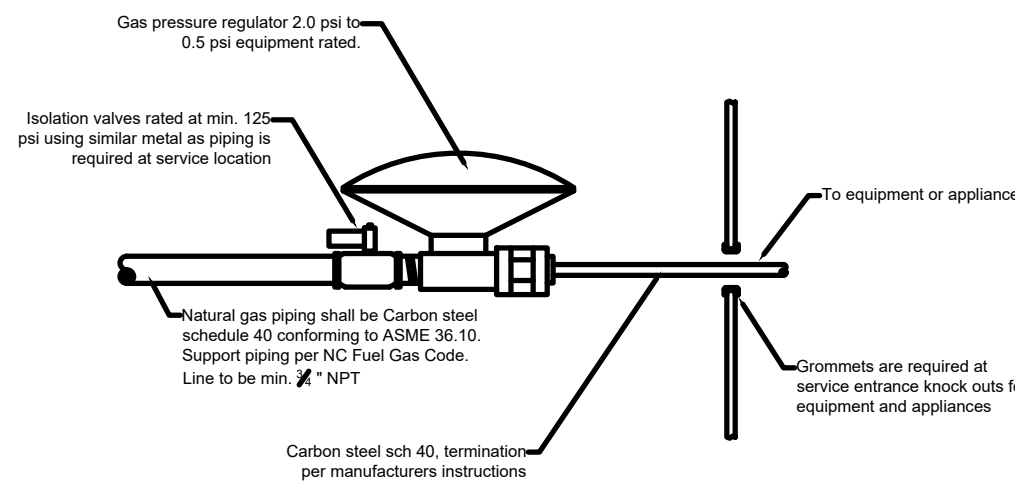
7 Pipe support detail
Scale: N/A



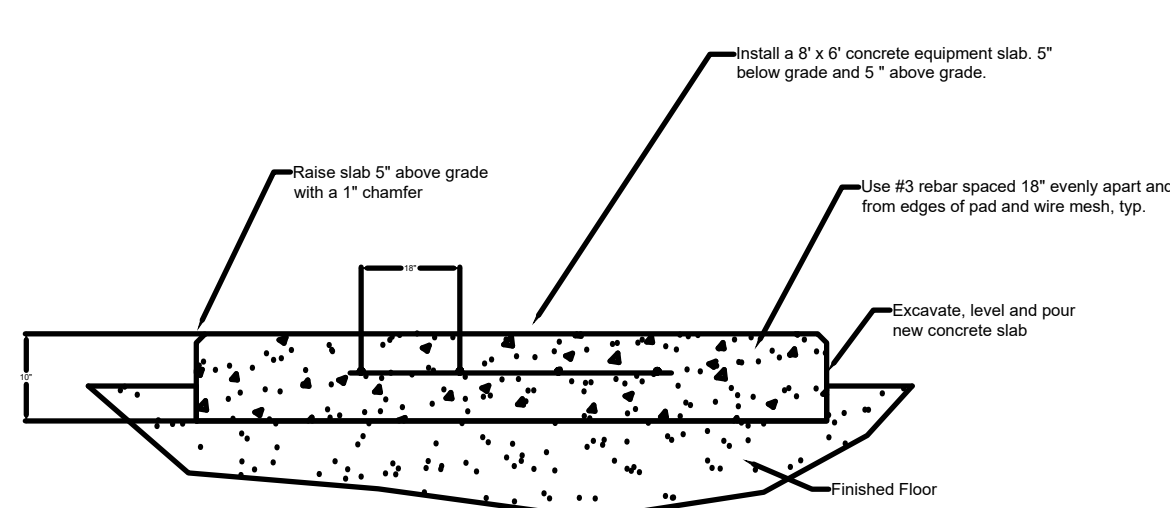
8 Duct Supports
Scale: N/A



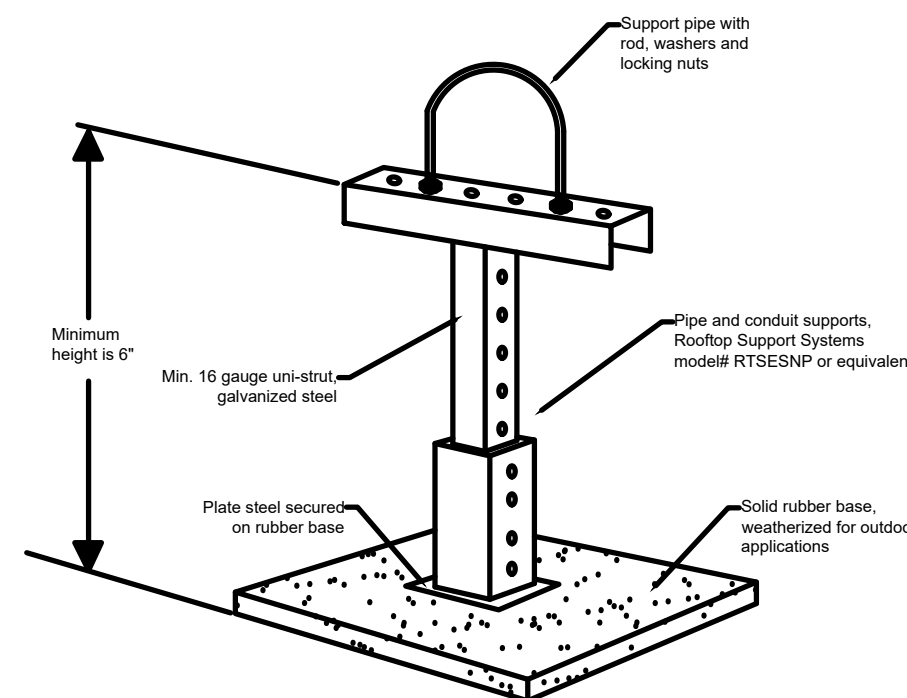
9 Condensate line detail
Scale: N/A



10 Gas regulator
Scale: N/A



11 AHU Support Pad
Scale: N/A



12 Roof Pipe Support
Scale: N/A

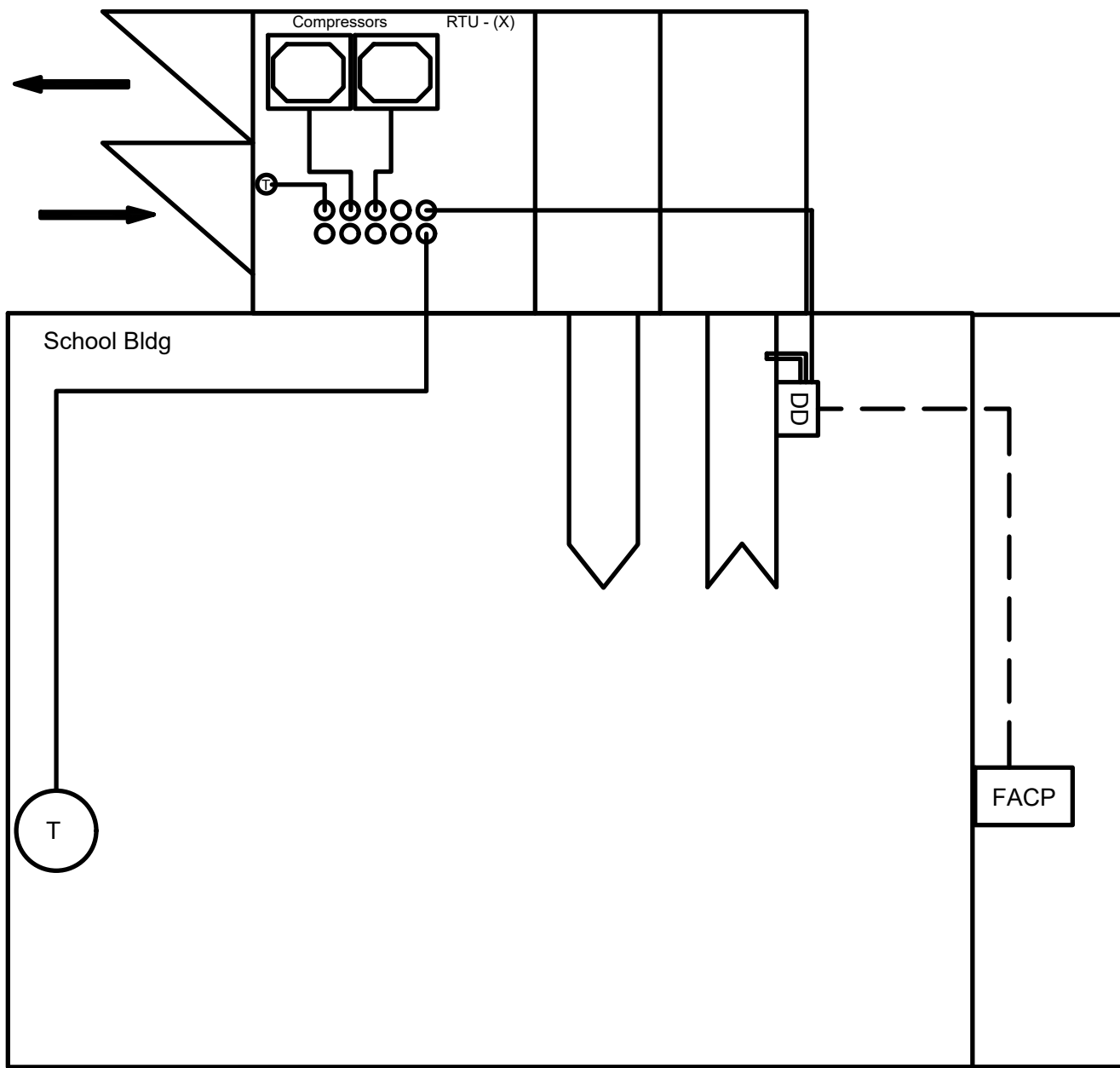
Hardware Points					Software Points					
Point Name	A I	A O	D I	D O	A S	D S	Schedule	Trend	Alarm	Shown on Graphic
O.A. Damper Act.		1			1					X
Condensing Unit				1		1				X
AHU Engagement				1		1				X
AHU Status			1							X
Supply Air Temp.	1				1			X		X
Outside Air Temp	1							X		X
Thermostat (BAS)			1							X
Occupied Schedule							1			
Errors									x	X
Totals:	1	1	2	2	2	2	1		x	8

TOTAL HARWARE POINTS: 6
TOTAL SOFTWARE POINTS: 5

LEGEND:
AI = ANALOG INPUT
AO = ANALOG OUTPUT
DI = DIGITAL INPUT
DO = DIGITAL OUTPUT
AS = ANALOG SETPOINT
DS = DIGITAL SETPOINT

3
M3.1

Schedule of control points
Scale: N/A



Rooftop Unit Sequence of Operations:

System Narrative:
The RTU system is designed to provide heating and cooling for the administrative areas via package units with direct expansion cooling and gas fired furnace. The units will control temperature using an in space wall thermostat. The units will be capable of full economizer mode and partial loading with sequenced compressors. Demand control will be achieved by programmable thermostat and outdoor air intake shall be capable up to 50% reduction.

Sequence Modes:
Occupied Mode: 7 day programmable and initially set for 9 hours, 6 days a week

Heating Mode: The initial setpoint for space temperature during heating mode shall be 68 deg F.
When occupied and thermostat is switched to heating mode then;
RTU-(X) compressors will switch off and supply fan to deliver (SA{x}) CFM and O.A. damper will adjust to (OA{x}) CFM outside air entering RTU-(x). Gas fired furnace shall activate and modulate to achieve and maintain inside temperature setpoint.

Economizer mode: RTU-(x) shall continue to run and provide the required ventilation when outside air is between +/- 5 degrees, but system will neither be in heating or cooling mode. (Dead band) RTU-(x)will maintain supply fan to (SA{x}) and O.A. damper will adjust to (OA{x}) CFM outside air entering RTU-(x).
Then RTU-(x) will compare the outside air and inside air conditions and modulate outside air and return air dampers to maintain the indoor temperature setting. Compressors will be available to provide partial load cooling if required to maintain the indoor temperature setting.

Cooling Mode: The initial setpoint for internal building temperature during cooling mode shall be 78 deg F.
When occupied and when thermostat is set to cooling then;
RTU-(x) will switch to cooling mode and condensing units will activate.
RTU-(x) will provide (SA{x}) CFM to the space and damper actuator will adjust to provide (OA{x}) CFM.
RTU-(x) will modulate air mixture and compressor loading using internal controls to deliver air to maintain T-Stat setpoint.

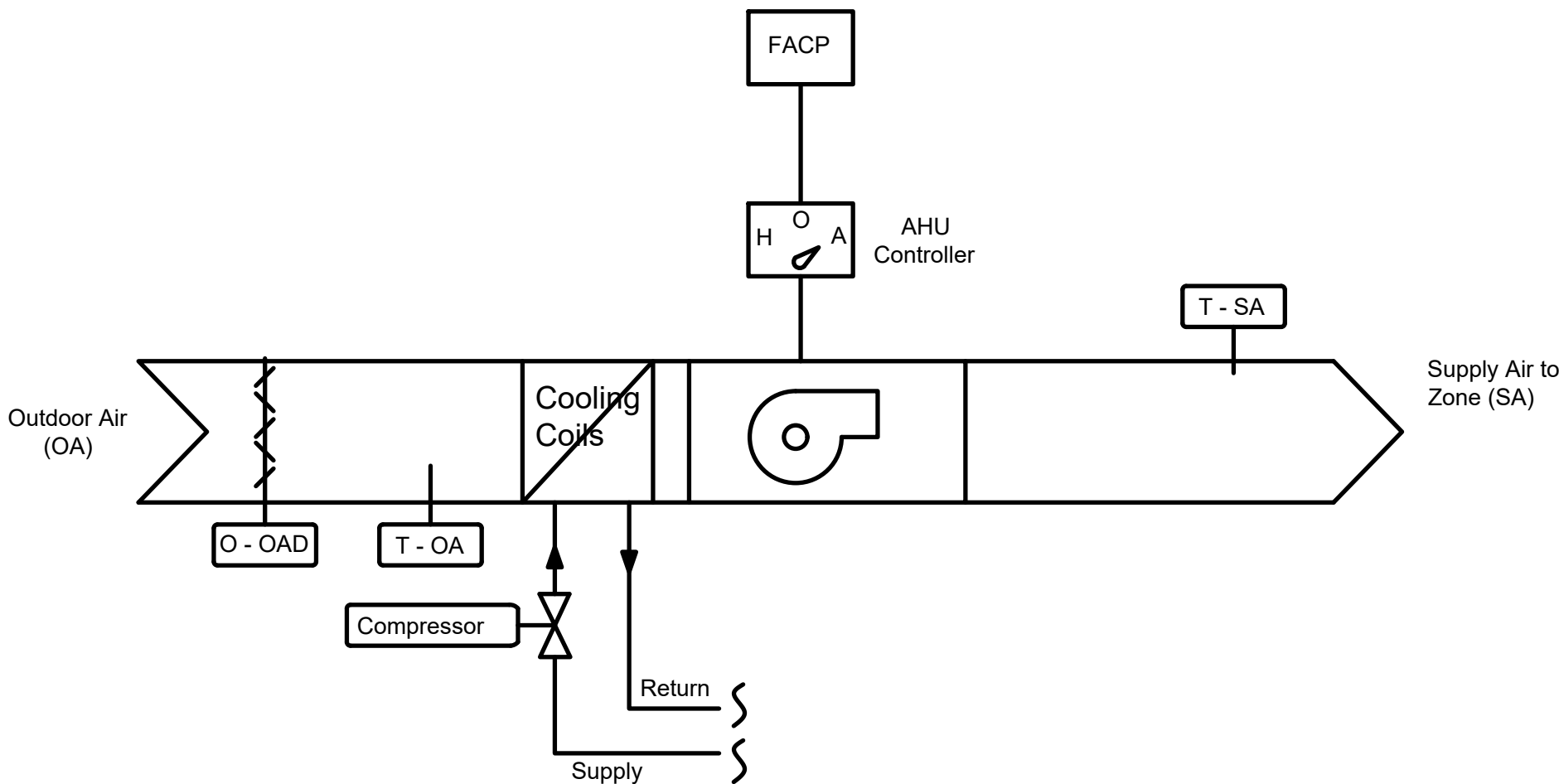
Faults:
When any fault condition is present the thermostat display will alarm until fault conditions are acknowledged and cleared.

Smoke detection:
If in-duct smoke detectors detect the presence of smoke in any return duct, then RTU-(x) will shutdown until the fault is cleared. A signal shall be sent to the building Fire Alarm Control Panel (FACP) notifying of a alarm condition.
Once alarm clears then system will reset to standard operating conditions.

Notes:
1. RTU-(x); where x is scheduled unit on plan.
2. SA{x}; where x is scheduled supply air on plan.
3. OA{x}; where x is scheduled outside air on plan.
4. Duct detectors shall be on returns greater than 2000 CFM.

1
M3.1

RTU Controls, N. Gas & DX
Scale: N/A



System Narrative: The air handlers will provide dehumidification, cooling and fresh air to zone during. During cooling or economizer mode, the air handler will provide warm fresh air to the zone. Zone control will be 7 day programmable. (Zone temperature = Z{x}, where x = 1,2,3... e.g. the zone designation) Initially set to 67° F.

OCCUPIED:
The unit will activate and run continuously during programmable occupied hours (initially set to 7:00 am to 6:00pm) and supply equipment design cfm air to zone.

HEATING MODE:
When in heating mode as defined by the programmed outdoor temperature dropping below the dead band limit then:
Zone Air Handler(s) will switch on, Outside air dampers will modulate to minimum outside air intake.

DEAD BAND MODE & ECONOMIZER MODE:
There shall be and adjustable dead band of minimum 10 degrees. Initially set to 67°F to 77°F.
Within dead band: (economizer mode); Zone Air Handler(s) will switch on, Outside air dampers (O - OAD) will modulate to maximum outside air intake. The compressor will turn on and cool outside air and reheat to neutral 74°F . As temperature rises above dead band, then the unit will switch to cooling mode.

COOLING MODE:
When in cooling mode as defined by the programmed outdoor temperature rising above the dead band limit then:
Zone Air Handler(s) will switch on, Outside air dampers will modulate to maximum outside air intake.
When the zone temperature rises above zone setpoint;
The compressor will turn on and modulate to control leaving supply air temperature (T- SA) and the zone air temperature (T- Z{x}).
When the zone temperature is satisfied; then the compressor will modulate to the standby status.

FREEZE PROTECTION:
During unoccupied hours; if the (T - RA) is below 34°F (adj), then (O - OAD) will modulate to minimum and unit will activate the electric heater to protect the chilled water coils.

EMERGENCY:
When a smoke is detected in return duct, the Rooftop unit will be sent the shutdown signal and remain off until the emergency condition is cleared.
An alarm condition to the fire alarm control panel (FACP) will be sent.
Once the emergency condition is cleared. the units will re-engage using last known parameters.

2
M3.1

DOAS Unit Controls & Seq. of Ops.: DX and Dehum
Scale: N/A

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/2025

Revisions

No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT

Project No:
01-2025015

Scale: N/A

Date: 09-16-2025

Title: Mechanical Controls

M3.1

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL
PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- A. Drawings: E0.1, E1.1, E1.2, E3.1 and E3.2

- 1.2 SUMMARY
- A. This section includes the following
1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

- 1.3 COORDINATION
- A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

- PART 2 - PRODUCTS
- 2.01 MANUFACTURERS
- A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.

- 2.2 INSPECTIONS
- A. Contractor shall contact the Cleveland County Inspections to schedule electrical inspections and to schedule a final inspection.

- PART 3 - EXECUTION
- 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. EMT to be used only in dry indoor locations with steel compression fittings and connectors.

END SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- A. Drawings: E0.1 and E1.1

- 1.2 SUMMARY
- B. This section includes the following
1. Requirements for building wire and cable

- 1.3 COORDINATION
- A. Coordinate electrical testing of electrical items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

- PART 2 - PRODUCTS
- 2.01 MANUFACTURERS
- A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.
- B. All building wire and cables should be listed by a North Carolina "approved" third party testing agency

- 2.2 INSPECTIONS
- A. Contractor shall contact the Cleveland County Inspections to schedule electrical inspections and to schedule a final inspection.

- PART 3 - EXECUTION
- 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

- 3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Provide and install an individual neutral wire for each branch circuit.
- B. Conductors for power and lighting that are sized #10 AWG and smaller shall be solid copper conductors. All power conductors that are #8 AWG and larger shall be class B stranded copper conductors.
- C. The minimum size for power branch circuit wiring is #12 AWG.
- D. Fire alarm and control wiring may be equipped with stranded conductors that are sized #14 AWG
- E. Branch circuit conductors should be sized to prevent a voltage drop exceeding (3%) and the maximum voltage drop on both feeders and branch circuits should not exceed (5%)

- F. Provide and install a full size individual neutral wire for each circuit.
- G. The insulation type for interior wiring shall be dual-rated THHN/THWN or XHHW.
- H. Where the conductor length from the panel to the first outlet on a 277 volt circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.
- I. Where the conductor length from the panel to the first outlet on a 120 volt circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.
- J. Joints in solid conductors shall be spliced using Ideal "wirenuts", 3M Company "Scotchlock" or T&B connectors in junction boxes, outlet boxes and lighting fixtures.
- K. "Sta-kon" or other permanent type crimp connectors shall not be used for branch circuit connections.
- L. Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with U/L-approved insulating covers, may be used instead of mechanical connectors plus tape.
- M. 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.
- N. The feeder, branch circuits shall be color coded.

END SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- PART 1 - GENERAL
- 1.1 RELATED DOCUMENTS
- A. Drawings: E0.1 and E1.1

- 1.2 SUMMARY
- C. This section includes the following
2. Grounding and bonding for raceways

- 1.3 COORDINATION
- A. Coordinate electrical testing of electrical items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

- PART 2 - PRODUCTS
- 2.01 MANUFACTURERS
- A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.
- B. All building wire and cables should be listed by a North Carolina "approved" third party testing agency

- 2.2 INSPECTIONS
- A. Contractor shall contact the Cleveland County Inspections to schedule electrical inspections and to schedule a final inspection.

- PART 3 - EXECUTION
- 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

- 3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. The raceway system shall be not be relied on for ground continuity. A green grounding conductor, properly sized per NEC Table 250-122, shall be run in all power raceways."
- B. Provide and install a green grounding conductor in all power
- C. Test grounding and bonding system with a ground resistance tester demonstrating the resistance to ground is less than 25 ohms. Where the resistance is more than 25 ohms additional grounding will be required.
- D. Grounding conductors, where insulated, shall be colored solid green. Conductors intended as neutral shall be colored solid white on 120/208 volt circuits and natural gray on 277/480 volt circuits.

END SECTION 260526

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS
PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- A. Drawings: E0.1 and E1.1

- 1.2 SUMMARY
- A. This section includes the following
1. Identification and labeling electrical systems

- 1.3 COORDINATION
- A. Electrician will properly label all electrical equipment with labels.

- PART 3 - EXECUTION
- 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

- 3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Furnish and install engraved laminated phenolic nameplates for all safety switches, panelboards, transformers, switchboards, motor control centers and other electrical equipment supplied for the project for identification. Nameplates shall be securely attached to equipment with self-tapping stainless steel screws; if the screw sharp end is protected; otherwise Rivets shall be used. Letters shall be approximately 1/2 inch high minimum. Embossed, self-adhesive plastic tape is not acceptable for marking equipment. Nameplate material colors shall be:
1. Blue surface with white core for 120/208 volt equipment.
2. Black surface with white core for 277/480 volt equipment.
3. Bright red surface with white core for all equipment related to fire alarm system.
4. Dark red (burgundy) surface with white core for all equipment related to security.
5. Green surface with white core for all equipment related to "emergency" systems.
6. Orange surface with white core for all equipment related to telephone systems.
7. Brown surface with white core for all equipment related to data systems.
8. White surface with black core for all equipment related to paging systems.
9. Purple surface with white core for all equipment related to TV systems.

- B. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.
- C. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined above. This includes covers on boxes above lift-out and other type accessible ceilings.

END SECTION 260553

SECTION 262726 - WIRING DEVICES
PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- A. Drawings: E0.1 and E1.1

- 1.2 SUMMARY
- A. This section includes the following
1. Specifications for the installations of wiring devices

- 1.3 COORDINATION
- A. Coordinate electrical testing of electrical items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

- PART 2 - PRODUCTS
- 2.01 MANUFACTURERS
- A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.
- B. Device shall be third party tested as noted per sub-section 3.2 part B.

- 2.2 INSPECTIONS
- A. Contractor shall contact the Cleveland County Inspections to schedule electrical inspections and to schedule a final inspection.

- PART 3 - EXECUTION
- 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

- 3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Toggle switches shall be single pole, three-way, or four-way as indicated on the drawings. Switches shall be of the grounding type, with hex-head grounding screw, rated 20A, 120/277 volt, A.C only. Lighted handle switches shall have neon lights of the correct voltage rating where indicated on the drawings. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be listed by an "approved" third-party agency, approved for the voltage and amperage indicated.
- B. Cover plates for flush mounted wiring devices and for telephone outlets shall be Type "302" stainless steel or nylon type, standard size, single or ganged as shown on the drawings. Cover plate mounting screws shall be slotted head oval screws and shall match the finish and material of the plate, and shall be furnished with the plate by the plate manufacturer. Quantity of 2% spare cover plates of each type shall be provided to the owner.
- C. Switch and receptacle cover plates on exposed work shall be galvanized cast ferrous metal, standard size, and shall be single or ganged as indicated on the drawings.
- D. Exterior mounted switch and receptacle plates, and those noted to be weatherproof, shall be weatherproof PVC cover plates, standard size, single or ganged as indicated on the drawings, and shall be "approved" third party listed as "rain-tight while in use."
- E. All receptacles (unless otherwise noted) shall be federal specification grade duplex receptacles.

END SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS
PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- A. Drawings: E0.1, E1.1, E1.2, E3.1 and E3.2

- 1.2 SUMMARY
- A. This section includes the following
1. Specifications for the installations of safety switches

- 1.3 COORDINATION
- A. Coordinate electrical testing of electrical items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

- PART 2 - PRODUCTS
- 2.01 MANUFACTURERS
- A. Manufacturers: Subject to compliance with requirements, provide products by standard electrical supply manufacturers.
- B. Device shall be third party listed.

- 2.2 INSPECTIONS
- A. Contractor shall contact the Cleveland County Inspections to schedule electrical inspections and to schedule a final inspection.

- PART 3 - EXECUTION
- 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Comply with NECA 1.
- B. Comply with NEC
- C. Comply with North Carolina Electrical Building Code

- 3.2 WORK REQUIREMENTS FOR ELECTRICAL INSTALLATION
- A. Safety switches shall be the "heavy duty" type. General duty switches are not acceptable.
- B. Switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "on" position.
- C. Switches shall have handles whose positions are easily recognizable in the "on" or "off" position. For safety reasons, padlock shall be provided for switches located in the public areas.
- D. Switches shall have non-teasible, positive, quick make-quick break mechanisms.
- E. Switches shall be properly labeled.

END SECTION 262816

General Installation Requirements

1. All installation work will be completed during normal business hours, exceptions will be made.
2. Competitive equipment may be used in lieu of models specified.
3. Drawing are diagrammatic, contractor will verify equipment positions and adjust power and controls conduit path accordingly.
4. Support conduit per NEC 2020.
5. Coordinate installation with other trades.
6. All wire must 75° C rated or higher, THW, THHW.

Electrical Installation Requirements

1. All electrical work must be done by a NC licensed electrician.
2. All electrical work must comply with the NEC 2020.
3. Wire connection shall be twist tied with appropriate sized cap.
4. All contractor provided electric materials, devices, appliances and equipment shall be label-listed by a North Carolina approved third party testing agency.
5. The new circuit breakers shall match existing breakers for actual interrupt capacity.
6. Conductors shall match existing color code as follows.
- 6.1. 277/480V, 3 Phase, 4 - Wire 208/120V, 3 Phase, 4-Wire
- 6.2. Phase A - Brown Phase A - Black
- 6.3. Phase B - Orange Phase B - Red
- 6.4. Phase C - Yellow Phase C - Blue
- 6.5. Neutral - Grey Neutral - White
7. Contractor to install circuits and update panels as shown in schedules.

Conductor Sizing Table

For 120V - 20A Branch Circuits Only, Unless Otherwise Noted

If distance A + B in feet is (see diagram below)	Use copper wire in metallic conduit, AWG size as follows on entire circuit and size conduit accordingly	
0' to 100'	#12 (min.)	
100' to 175'	#10	
175' to 300'	#8	
300' to 450'	#6 (max.)	

For 277V - 20A Branch Circuits Only, Unless Otherwise Noted

If distance A + B in feet is (see diagram below)	Use copper wire in metallic conduit, AWG size as follows on entire circuit and size conduit accordingly	
0' to 250'	#12 (min.)	
250' to 400'	#10	
400' to 700'	#8	
700' to 1000'	#6 (max.)	

These tables are based on an evenly distributed load allowing 3% voltage drop at last outlet:

Motor Starter Controller Schedule

Tag	Manufacturer	Description	Equip.	Fuse	Nema	Size	Volts/Ph	Mounting	Comments
MS1	Square D	Combination Starter, Type S, Fusible Disconnect	MU-1	15	1	1	480/ 3ø	Wall	1, 2, 3, 4, 5

Comments:

1. Modbus/ BAC/net capable, Minimum 6 I/O, analog and digital
2. UL Listed
3. Integral Disconnect (15 amps)
4. Enclosed bypass configuration
5. Comparable manufacturers are ABB, Schneider Electric, Siemens

Legends, Symbols & Icons

Lighting fixture, flourescent, 4 bulb, see schedule for details

Lighting fixture, high pressure sodium, see schedule for details

Lighting fixture, metal halide, see schedule for details

Lighting fixture w/ motion detector, 2 bulb, see schedule for details

Lighting fixture, directional, single bulb, see schedule for details

Lighting fixture, recessed, single bulb, see schedule for details

Emergency exit sign, see schedule for details

Emergency exit sign and egress lighting, see schedule for details

Emergency notification appliance

Emergency pull station

Power supply meter

Emergency annunciator appliance

Lighting fixture, miscellaneous, see schedule for details

Panelboard, see schedule for details

Transformer, dry type, see schedule for details

Motor, Type 1,see schedule for specs

Motor controller, Type 1,see schedule for specs

Combination motor controller & disconnect, Type 1,see schedule for specs

Combination motor controller & circuit breaker, Type 1,see schedule for specs

Push button station, momentary contact

Push button station, maintained contact

Hand - Off - Auto type, motor control unit

Outlet - Box - Relay

Junction Box

Disconnect Box, see specs for details

Automatic transfer switch, see specs for details

Data Communications Outlet

Residential Telephone jack, typ.

Smoke detector, see specs for details

Audible horn or annunciator, see specs for details

AV Outlet

Duplex Outlet, 15 Amp, 3W, 125V, Flush mounted

Quad Outlet, 15 Amp, 3W, 125V, Flush mounted

Outlet, 20 Amp, 3W, 250V, NEMA 6-20R

Outlet, 20 Amp, 3W, 250V, NEMA L6-20R

Outlet, 15 Amp, 3W, 250V, NEMA 6-15R

GFCI Duplex Outlet, 15 Amp, 3W, 125V, Flush Mount

GFCI Duplex Outlet, 15 Amp, 3W, 125V, WP, Outdoor Duty

Outlet - Box - Mounted Dimmer

Outlet - Box - Mounted Switch and Dimmer

Switch, inline, 125V, single pull. flush mounted

Switch, inline, 125V, three way. flush mounted

Switch, inline, low voltage, single pull. flush mounted

Switch, inline, 125V, double pull. flush mounted

Switch, inline, 125V, 4 way. flush mounted

Switch, inline, 125V, key operated. flush mounted

Switch, door operated see spec for details

Switch, weather proof enclosure see spec for details

Switch, momentary contact

Occupancy Sensor and Switch

Conduit and Wire for Power

Conduit and wire concealed under floor

Low voltage control wire

Home run to panelboard

Empty Conduit

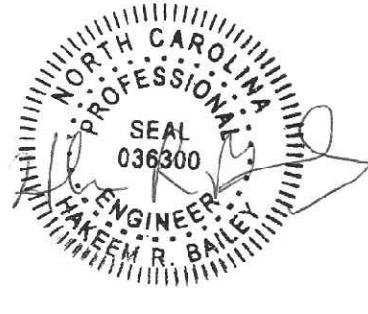
Non-metallic cable (romex type) wiring

Connect to existing at this point

Remove to this point

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone Number: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal: 09/29/25

Revisions

No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT

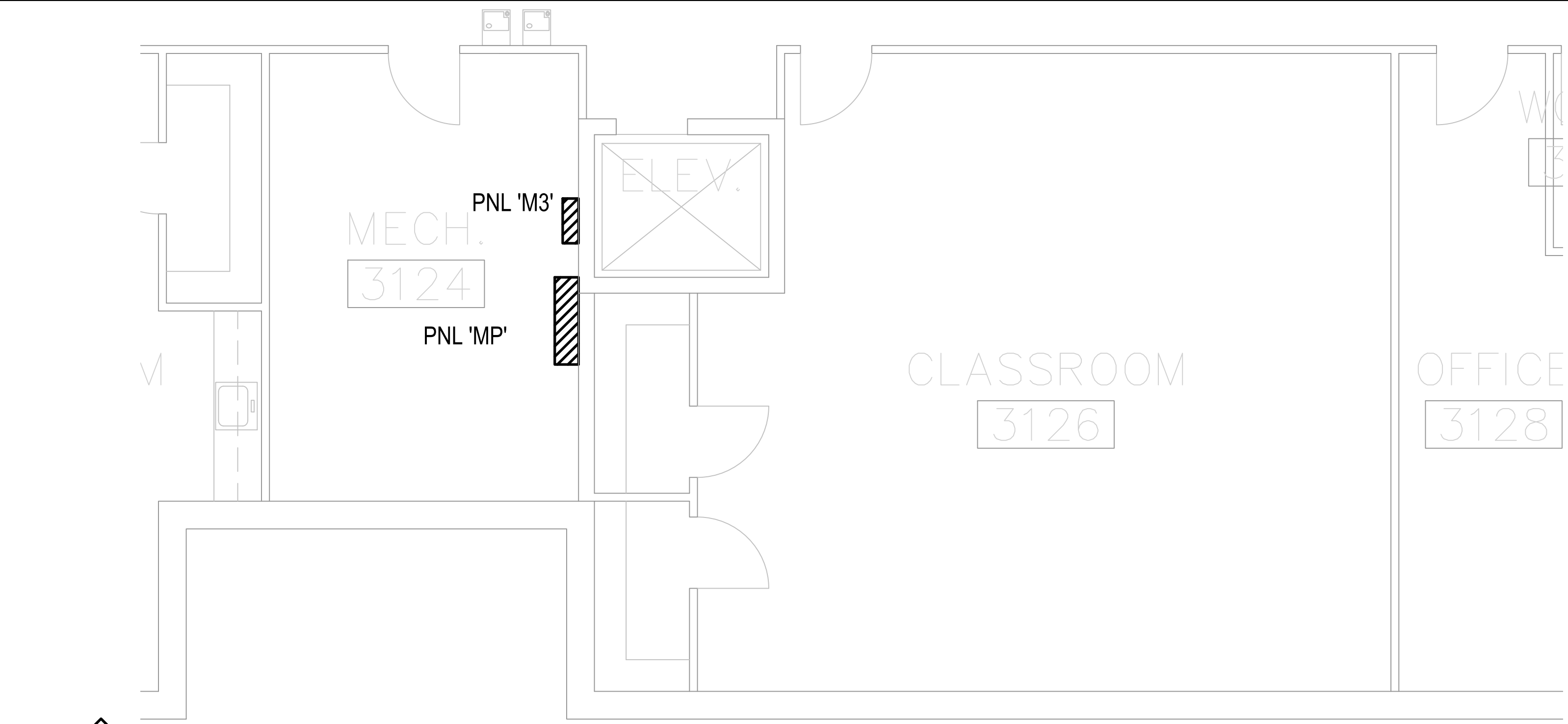
Project No:
01-2025015

Scale: N/A

Date: 09-16-2025

Title: Electrical Schedules

E0.1

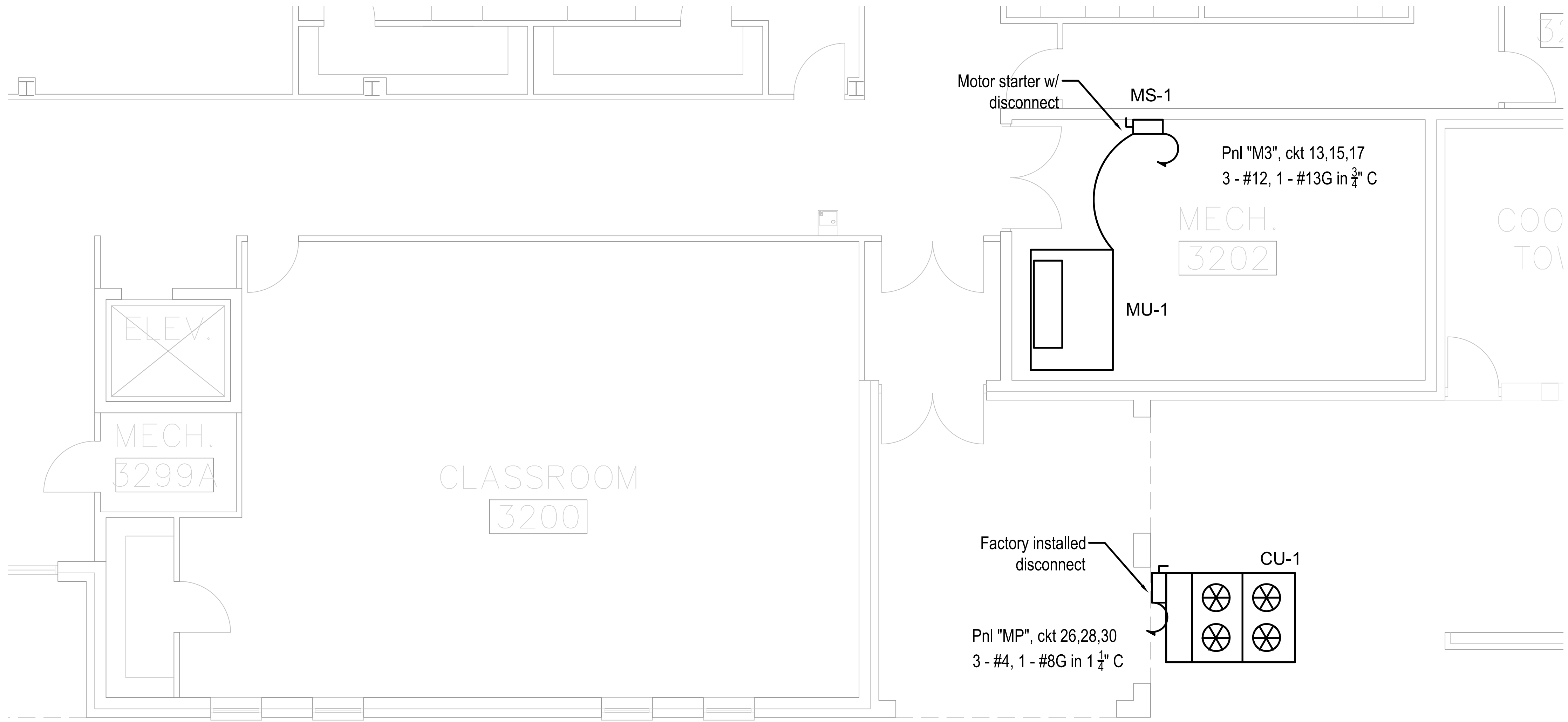


1

E1.1

Electrical Plan - 1st Floor Paksoy Bldg

Scale: 1/4" = 1' - 0"

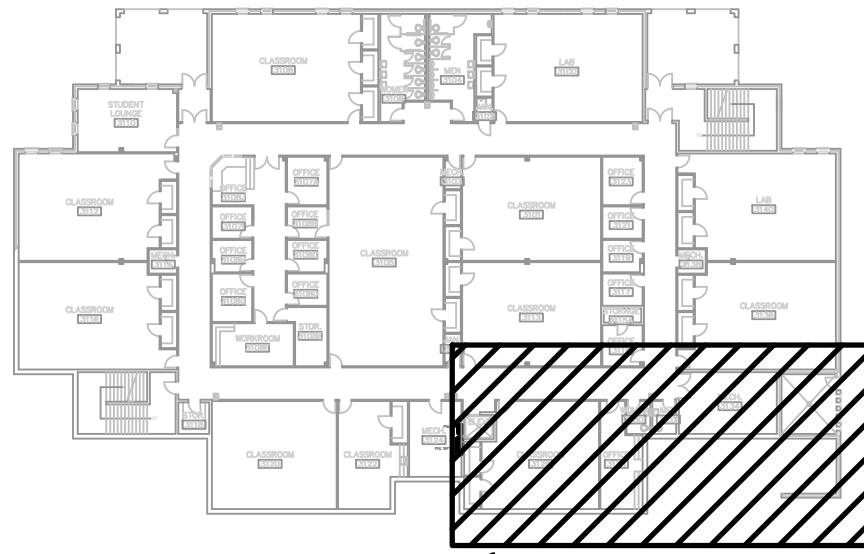


1

E1.1

Electrical Plan - 2nd Floor Paksoy Bldg

Scale: 1/4" = 1' - 0"



Key Plan

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone Number: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.

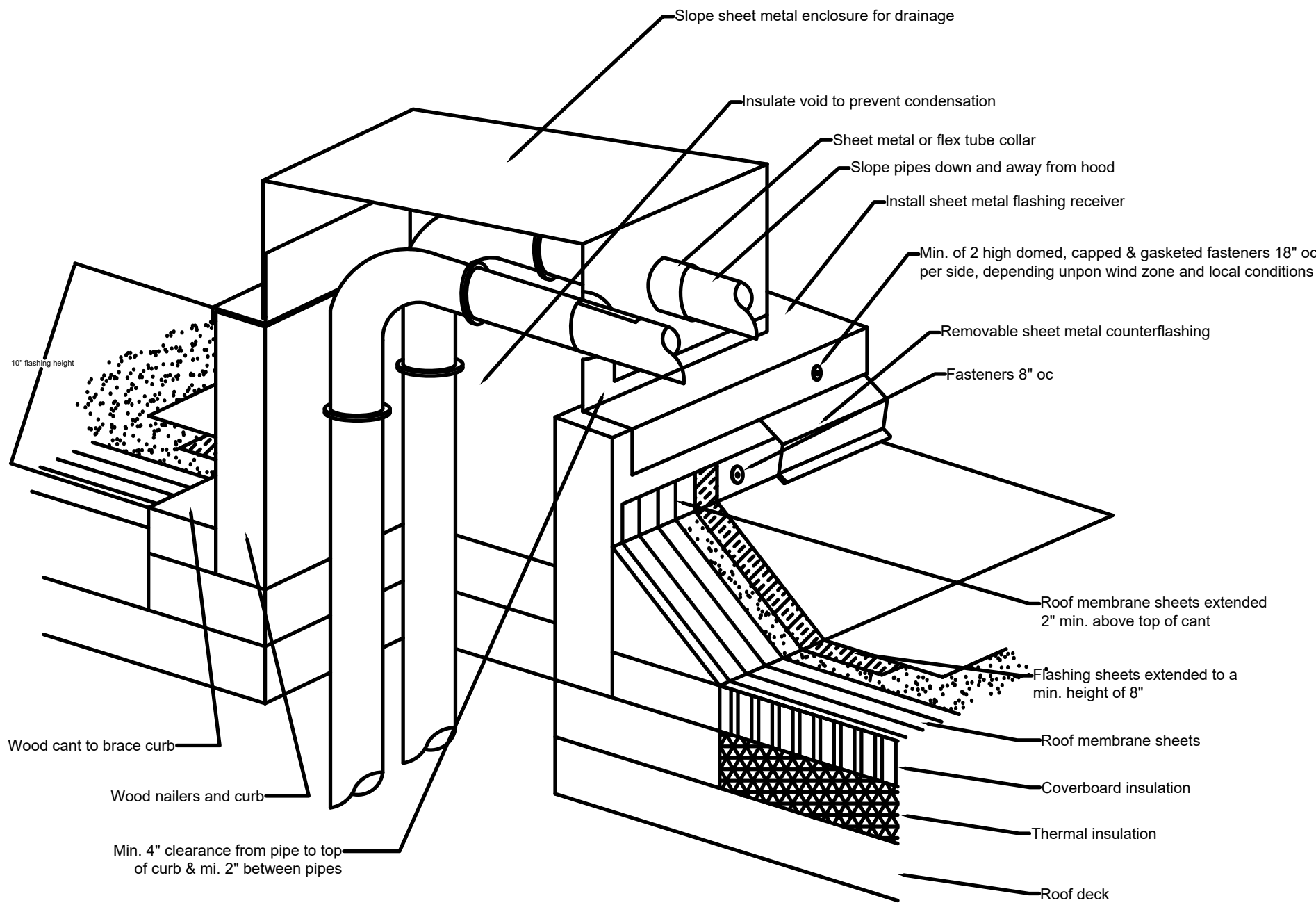
Seal: 09/29/25

Revisions	
No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

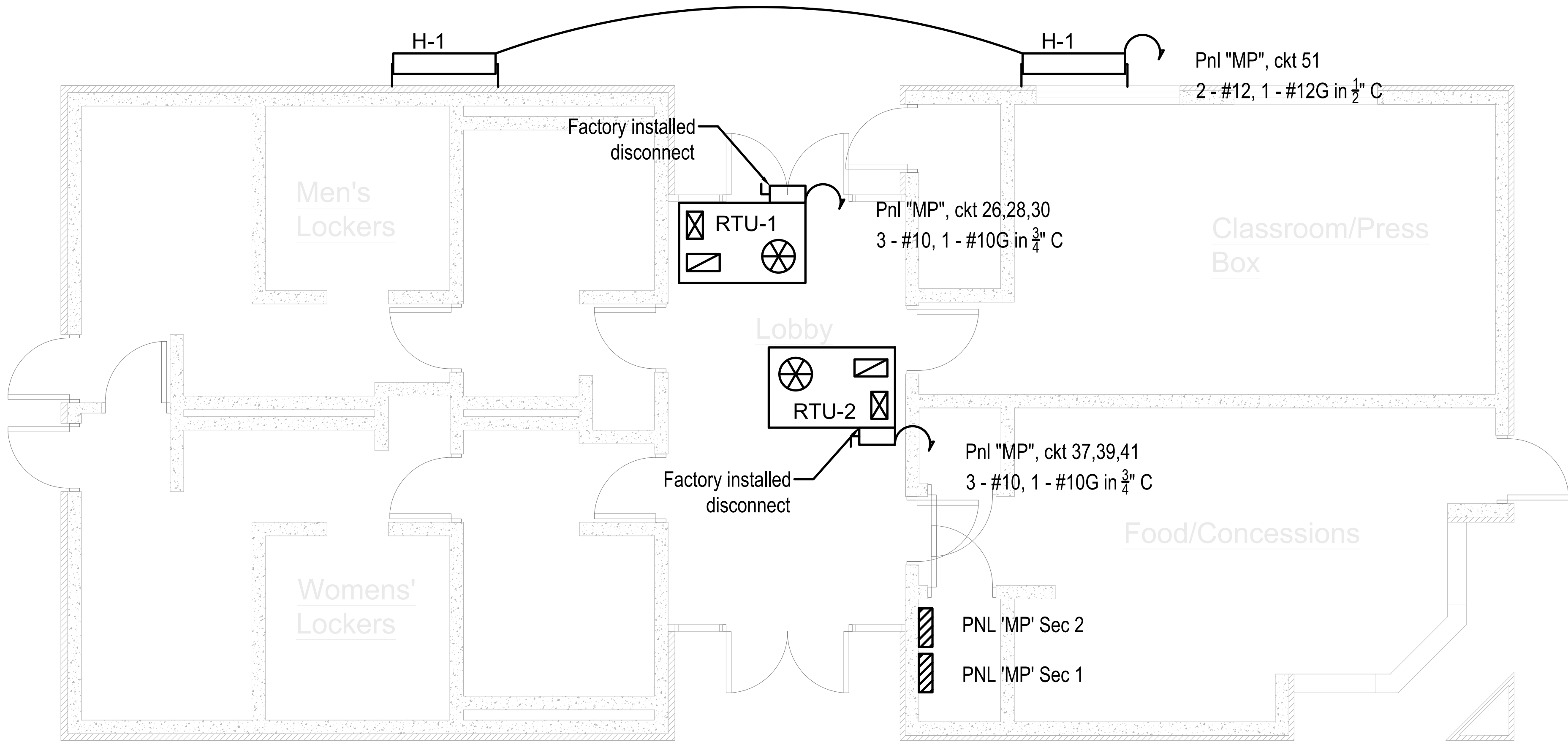
COPYRIGHT
Project No: 01-2025015
Scale: 1/2" = 1' - 0"
Date: 09-16-2025
Title: Electrical Plan - Paksoy Bldg

E1.1



2
E1.2

Pitch Pocket Detail
Scale: NTS

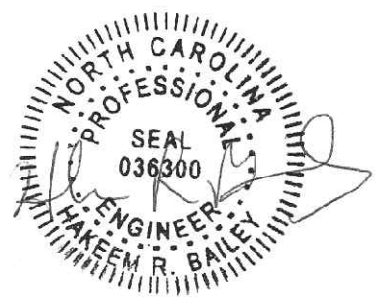


1
E1.2

Electrical Plan - Field House
Scale: 1/4" = 1' - 0"

AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone Number: 704 469 8463

Note:
This drawing is the property of the firm, AeroRaq Engineering. Reproduction in part or in whole is forbidden without written permission.



Seal:

Revisions	
No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT
Project No: 01-2025015
Scale: 1/4" = 1' - 0"
Date: 09-16-2025
Title: Electrical Plan - Field House

E1.2

Panelboard: "MP" Existing - General Electric Voltage: 277/480 V		Main Bus Rating: Main C/B Rating:			1000 Amps 1000 Amps		Type: Location:		Mechanical Room 3124 Floor																																														
					Phase Load																																																		
Ckt	Load Served	kVA	Wire Size	Ckt Brk	A	B	C	Ckt Brk	Wire Size	kVA	Load Served	Ckt																																											
1				225	0							2																																											
3	Transfer SW		ETR			0						3																																											
5			ETR	3			0					4																																											
7		66.67	ETR	300	143.9			350	ETR	77.23		5																																											
9	Boiler	66.67	ETR			143.9			ETR	77.23	Transformer	6																																											
11		66.67	ETR				143.9	3	ETR	77.23		7																																											
13		66.67	ETR	3				150	ETR	13.33		8																																											
15	Spare		ETR	100	13.33				ETR	13.33		9																																											
17			ETR	3			13.33	3	ETR	13.33	Elevator	10																																											
19		15.40	ETR	3	15.4							11																																											
21	Panel "M3"	15.40	ETR	100		15.4					Space	12																																											
23		15.40	ETR	3			15.4					13																																											
25		53.43	ETR	250	67.83			70	4	14.4		14																																											
27	Panel "M1"	53.43	ETR			67.83		4	4	14.4	CU-1 Condensing Unit	15																																											
29		53.43	ETR	3			67.83	3	4	14.4		16																																											
31					0							17																																											
33						0						18																																											
35							0					19																																											
37												20																																											
39							0					21																																											
41							0					22																																											
		Phase Load (kVA)			240.5	240.5	240.5	NEMA Rating:			1																																												
		Phase Load (Amps)			868.1	868.1	868.1	Min. Interrupt Capacity: 22k AIC																																															
<table><tr><th colspan="4">Load Demand Tabulation</th></tr><tr><th>Connected Load (kVA)</th><th>Factor</th><th colspan="2">Demand</th></tr><tr><td>Lighting</td><td>0.00</td><td>1.25</td><td>0.00</td></tr><tr><td>Receptacles</td><td>0.00</td><td>1</td><td>0.00</td></tr><tr><td>HVAC</td><td>243.21</td><td>1</td><td>243.21</td></tr><tr><td>Water Heating</td><td>0.00</td><td>1</td><td>0.00</td></tr><tr><td>Motors</td><td>0.00</td><td>1.25</td><td>0.00</td></tr><tr><td>Kitchen</td><td>0.00</td><td>1</td><td>0.00</td></tr><tr><td>Misc.</td><td>478.17</td><td>1</td><td>478.17</td></tr><tr><td>Total Demand Load</td><td></td><td></td><td>721.38</td></tr><tr><td>Total Demand Amps</td><td></td><td></td><td>867.69</td></tr></table>												Load Demand Tabulation				Connected Load (kVA)	Factor	Demand		Lighting	0.00	1.25	0.00	Receptacles	0.00	1	0.00	HVAC	243.21	1	243.21	Water Heating	0.00	1	0.00	Motors	0.00	1.25	0.00	Kitchen	0.00	1	0.00	Misc.	478.17	1	478.17	Total Demand Load			721.38	Total Demand Amps			867.69
Load Demand Tabulation																																																							
Connected Load (kVA)	Factor	Demand																																																					
Lighting	0.00	1.25	0.00																																																				
Receptacles	0.00	1	0.00																																																				
HVAC	243.21	1	243.21																																																				
Water Heating	0.00	1	0.00																																																				
Motors	0.00	1.25	0.00																																																				
Kitchen	0.00	1	0.00																																																				
Misc.	478.17	1	478.17																																																				
Total Demand Load			721.38																																																				
Total Demand Amps			867.69																																																				
Notes: Panel is existing, Panel is fully rated, Paksoy Bldg																																																							

Panel Board: "M3" Existing - General Electric Voltage: 277 / 480 V				Main Bus Rating: MLO Rating:				100 Amps 100 Amps				Type: Distribution Location: Mechanical Room 3124 Mounting: Wall			
Ckt	Load Served	kVA	Wire Size	Ckt Brk	Phase Load			Ckt Brk	Wire Size	kVA	Load Served	Ckt			
					A	B	C								
1		0.25	ETR	20	2.75			20	ETR	2.5		1			
3	Motor #14	0.25	ETR	20		2.75		3	ETR	2.5	Motor #11	6			
5		0.25	ETR	3			2.75	3	ETR	2.5		8			
7	Motor #12	0.25	ETR	20	2.75			20	ETR	2.5	Motor #11	10			
9		0.25	ETR	3		2.75		3	ETR	2.5		12			
11		0.25	ETR	3			2.75	3	ETR	2.5		14			
13		2.20	12	20	7.2			20	ETR	5.0		16			
15	MU-1	2.20	12	3		7.2		3	ETR	5.0	Motor #16	18			
17		2.20	12	3			7.2	3	ETR	5.0		20			
19		0.67	ETR	3	2.67			3	ETR	2.0		22			
21	Motor #17	0.67	ETR			2.67		3	ETR	2.0	Motor #18	24			
23		0.67	ETR	3			2.67	3	ETR	2.0		26			
25					0							28			
27						0						30			
29							0					32			
31					0							34			
33						0						36			
35							0					38			
37					0							40			
39												42			
41							0					44			
Phase Load (kVA)					15.4	15.4	15.4	NEMA Rating:					1		
Phase Load (Amps)					55.5	55.5	55.5	Min. Interrupt Capacity: 65k AIC							

Load Demand Tabulation			
Connected Load (kVA)	Factor Demand		
Lighting	0.00	1.25	0.00
Receptacles	0.00	1	0.00
HVAC	46.11	1	46.11
Water Heating	0.00	1	0.00
Motors	0.00	1.25	0.00
Kitchen	0.00	1	0.00
Misc.	0.00	1	0.00
Total Demand Load			46.11
Total Demand Amps			55.46

Notes:
Panel is existing, Panel is fully rated, Paksoy Bldg

Panelboard: "MP" Section 1				Main Bus Rating: 400 Amps			Type: Service	
Existing - Square D NQOB				Main C/B Rating: 400 Amps			Location: Mechanical Closet	
Voltage: 120/208 V							Mounting: Wall	

Ckt	Load Served	kVA	Wire Size	Ckt Brk	Phase Load			Ckt Brk	Wire Size	kVA	Load Served	Ckt
					A	B	C					
1	Lights		ETR 20		0			20	ETR		Recepts	2
3	Lights		ETR 20			0		20	ETR		Recepts	4
5	Lights		ETR 20				0	20	ETR		Recepts	6
7	Recepts		ETR 20		0			20	ETR		Recepts	8
9	Lights		ETR 20			0		20	ETR		Recepts	10
11	Lights		ETR 20				0	20	ETR		Recepts	12
13	Recepts		ETR 20		0			20	ETR		Recepts	14
15	Recepts		ETR 20			0		20	ETR		Fan F3	16
17	Recepts		ETR 20				0	20	ETR		Lights	18
19	Recepts		ETR 20		0			20	ETR		Lights	20
21	Recepts		ETR 20			0		20	ETR		Fan F5	22
23	Recepts		ETR 20				0	2	ETR		Fan F5	24
25	Fan F4		ETR 20		3.14			30	10	3.14	RTU-1	26
27	Spare		40			3.14		10	10	3.14	RTU-1	28
29	Spare		2				3.14	3	10	3.14	RTU-1	30

	Phase Load (kVA)	3.1	3.1	3.1	NEMA Rating:	1
	Phase Load (Amps)	26.2	26.2	26.2	Min. Interrupt Capacity: 22k AIC	

Load Demand Tabulation			
Connected Load (kVA)	Factor Demand		
Lighting	3.14	1.25	3.93
Receptacles	6.28	1	6.28
HVAC	0.00	1	0.00
Water Heating	0.00	1	0.00
Motors	0.00	1.25	0.00
Kitchen	0.00	1	0.00
Misc.	9.42	1	9.42
Total Demand Load			19.63
Total Demand Amps			54.47

Notes:

Panel is existing. The replacement of 3 and 4 ton units with two 3 ton units results in a net decrease of power

Panel/Board: "MP" Section 2		Main Bus Rating:		400 Amps		Type:		Service	
Existing: Square D NQOB		Main C/B Rating:		400 Amps		Location:		Mechanical Closet	
Voltage: 120/208 V						Mounting:		Wall	

Ckt	Load Served	kVA	Wire Size	Ckt/Bkr	Phase Load			Ckt/Bkr	Wire Size	kVA	Load Served	Ckt
					A	B	C					
31	Unit Heater		ETR	20	0			20	ETR		Water Heater	32
33	Unit Heater		ETR	20		0		20	ETR		Canopy	34
35	Unit Heater		ETR	3			0	20	ETR		Lights	36
37	RTU-2	3.14	10	30	3.14			20	ETR		Lights	38
39	RTU-2	3.14	10			3.14		20	ETR		Spare	40
41	RTU-2	3.14	10	3			3.14	20	ETR		Water Cooler	42
43	Telephone		ETR	20		0		20	ETR		Fan F1 & F2	44
45	Spare		ETR	20		0		50	ETR		Grill	46
47	Spare		ETR	20			0	3	ETR		Grill	48
51	H-1 (Patio Heaters)	0.12	12	15	0.12			3	ETR		Grill	50
53	Shunt					0		50	ETR		Fryer	52
55	Fryer		ETR	50			0		Fryer		Fryer	54
57	Fryer		ETR		0			3	ETR		Fryer	56
59	Fryer		ETR	3		0					Shunt	58

Phase Load (kVA)				3.3	3.1	3.1	NEMA Rating:	1
Phase Load (Amps)				27.2	26.2	26.2	Min. Interrupt Capacity: 22kAIC	

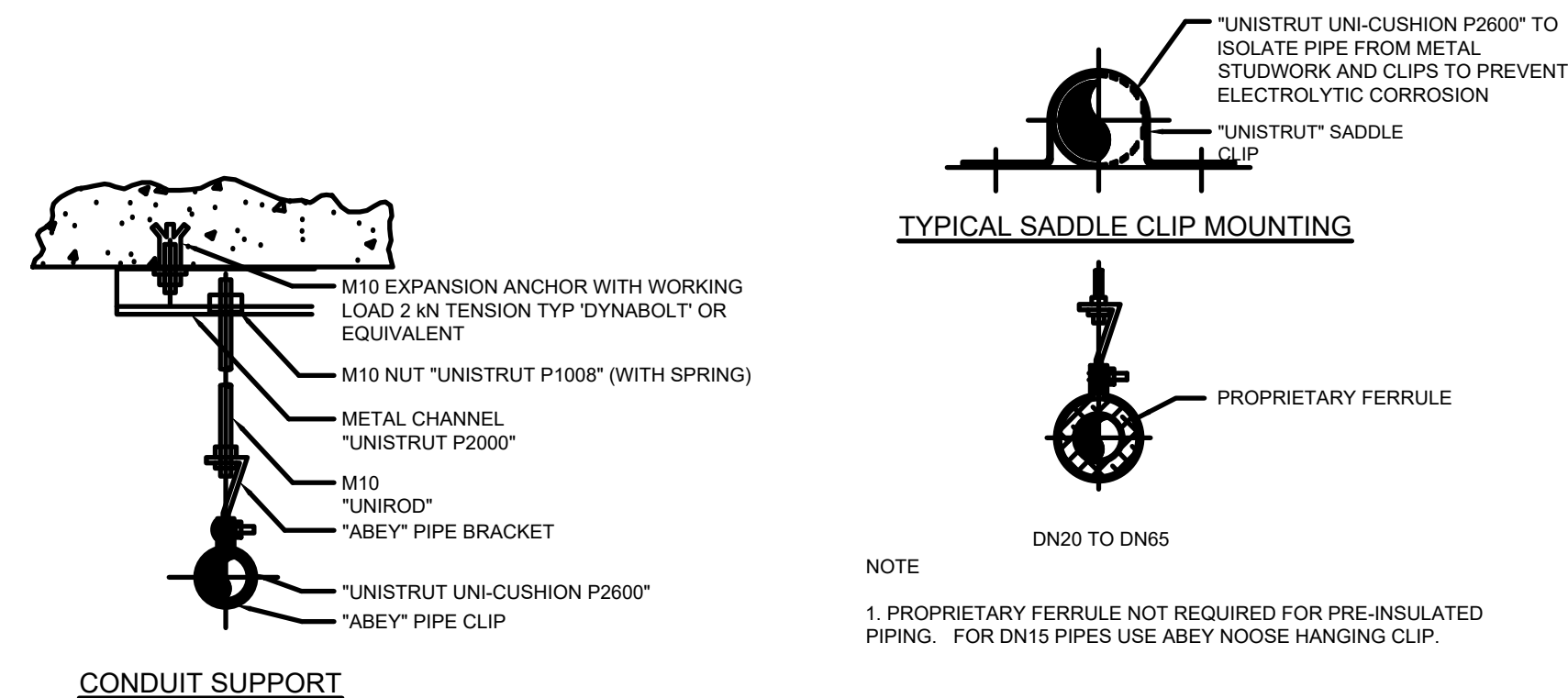
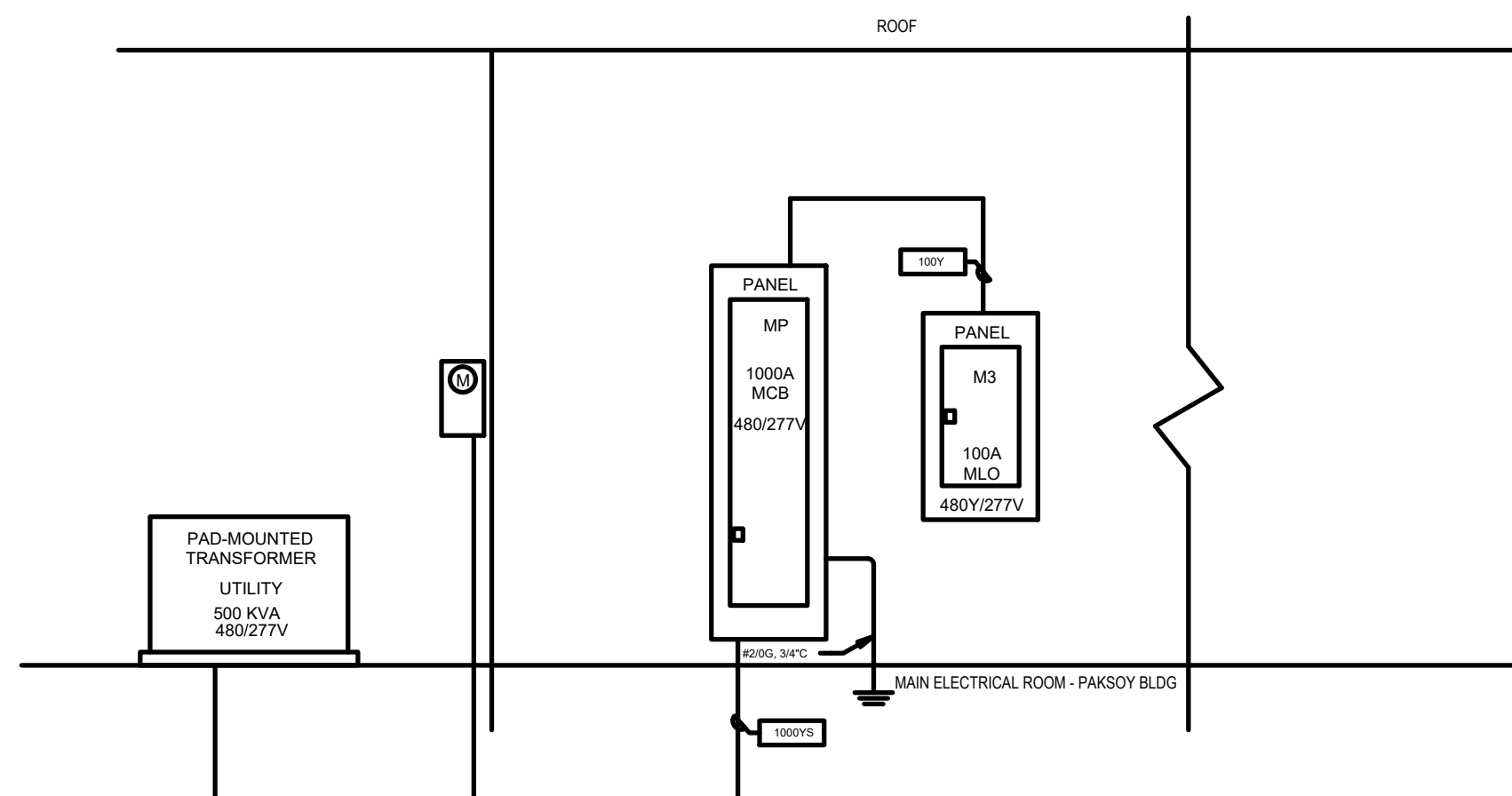
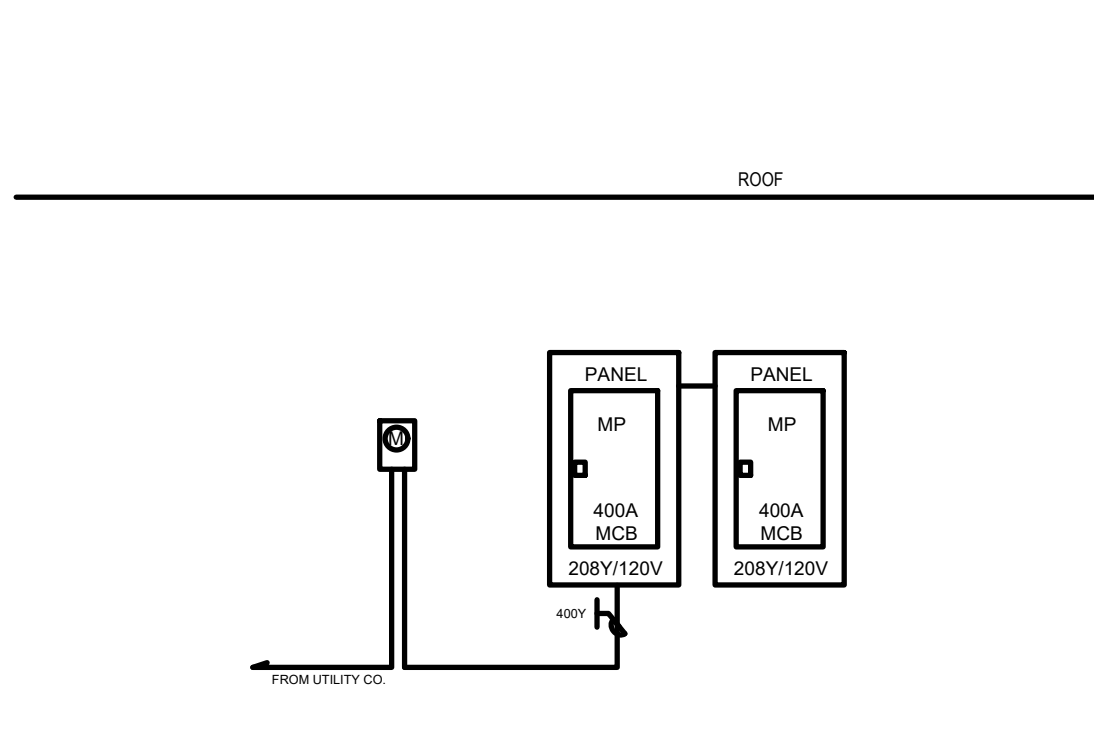
Connected Load (kVA)	Factor	Demand
Lighting	0.00	1.25
Receptacles	0.00	1
HVAC	3.14	1
Water Heating	0.00	1
Motors		1.25
Kitchen	6.28	1
Misc.	0.12	1
Total Demand Load		9.54
Total Demand Amps		26.48

Notes:

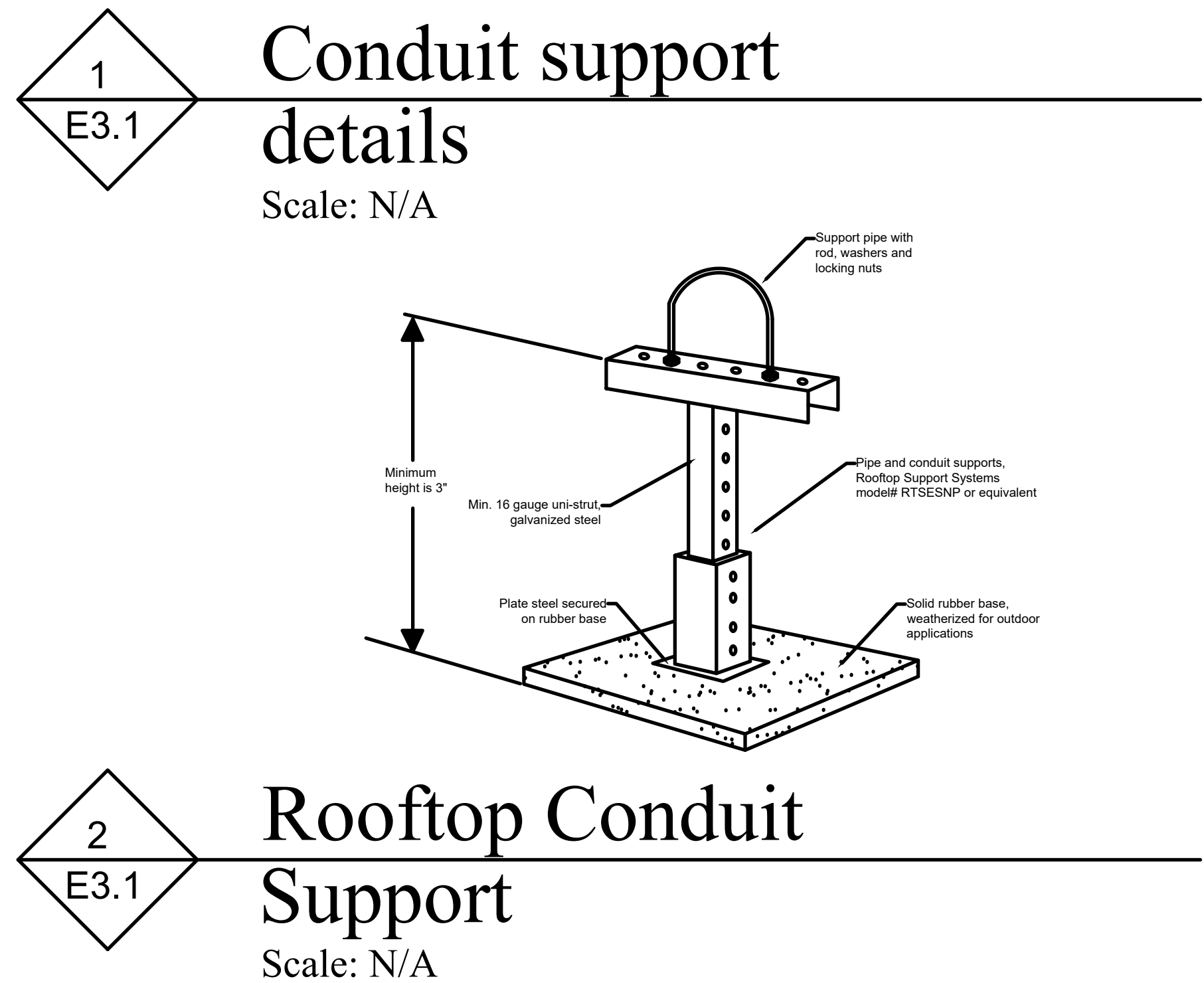
Panel is existing. The replacement of 3 and 4 ton units with two 3 ton units results in a net decrease of power

Existing Building 1000 Amp Service Switch Load Justification, per NEC 220.87, pg 70-75	
Existing Demand 253.0 KWD @125% =	316.3 kVA
New connected kVA on 1000 Amp Service Switch =	43.21 kVA
Total kVA utilized post construction =	359.5 kVA
Average Load per Phase =	432.4 Amps

Existing Building 400 Amp Service Switch		
Load Justification, per NEC 220.87, pg 70-75		
Existing Demand 97.0 KWD @125% =	121.25 kVA	
New connected KVA on 400 Amp Service Switch =		00.00 kVA
Total kVA utilized post construction =		121.25 kVA
Average Load per Phase =		336.6 Amps

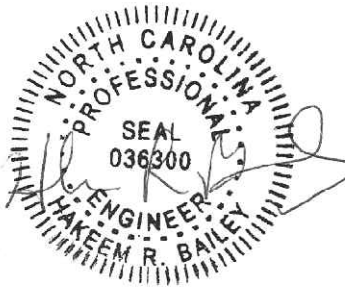


FEEDER SCHEDULE			
FEEDERS BASED ON 60C COPPER WIRE		FEEDERS BASED ON 75C COPPER WIRE IN EMT TYPE CONDUIT WITH COPPER GROUND WIRE	
			TRANSFORMER SECONDARY
#12A	3#12, #12G, 3/4"C	#12A	4#12, #12G, 3/4"C
#12B	3#12, #12G, 3/4"C	#12B	4#12, #12G, 3/4"C
#10A	3#10, #10G, 3/4"C	#10A	4#10, #10G, 3/4"C
#10B	3#10, #10G, 3/4"C	#10B	4#10, #10G, 3/4"C
#8A	3#8, #10G, 3/4"C	#8A	4#8, #10G, 3/4"C
#8B	3#8, #10G, 3/4"C	#8B	4#8, #10G, 3/4"C
#6A	3#6, #10G, 3/4"C	#6A	4#6, #10G, 3/4"C
#6B	3#6, #10G, 3/4"C	#6B	4#6, #10G, 3/4"C
#4A	3#4, #10G, 1" C	#4A	4#4, #10G, 1" C
#4B	3#4, #8G, 1" C	#4B	4#4, #8G, 1-1/4"C
#3A	3#3, #8G, 1-1/4"C	#3A	4#4, #8G, 1-1/4"C
#3B	3#2, #8G, 1-1/4"C	#3B	4#3, #8G, 1-1/4"C
#2A	3#1, #8G, 1-1/4"C	#2A	4#3, #8G, 1-1/4"C
		#2B	4#2, #8G, 1-1/4"C
#12A	4#12, #12G, 3/4"C	#12A	4#1, #8G, 1-1/2"C
#12B	4#12, #12G, 3/4"C	#12B	4#10, #6G, 2" C
#10A	4#10, #10G, 3/4"C	#10A	4#8, #6G, 2" C
#10B	4#10, #10G, 3/4"C	#10B	4#30, #6G, 2" C
#8A	4#8, #10G, 3/4"C	#8A	4#40, #4G, 2-1/2"C
#8B	4#8, #10G, 3/4"C	#8B	4-250KCML, #4G, 2-1/2"C
#6A	4#6, #10G, 1" C	#6A	4-350KCML, #4G, 3" C
#6B	4#6, #10G, 1" C	#6B	4-500KCML, #3G, 3-1/2"C
#4A	4#4, #10G, 1-1/4"C	#4A	2(4#30, #3G, 2" C)
#4B	4#4, #8G, 1-1/4"C	#4B	2(4#40, #2G, 2-1/2"C)
#3A	4#3, #8G, 1-1/4"C	#3A	2(4-250KCML, #2G, 2-1/2"C)
#3B	4#2, #8G, 1-1/4"C	#3B	2(4-350KCML, #1G, 3" C)
#2A	4#1, #8G, 1-1/2"C	#2A	2(4-500KCML, #10G, 3" C)
		#2B	3(4-300KCML, #10G, 2-1/2"C)
		#2C	3(4-350KCML, #20G, 2-1/2"C)
		#2D	3(4-400KCML, #20G, 3" C)
		#2E	4(4-350KCML, #30G, 2-1/2"C)
		#2F	4(4-350KCML, #30G, 3" C)
		#2G	4(4-350KCML, #30G, 3" C)
		#2H	4(4-350KCML, #30G, 3" C)
		#2I	4(4-350KCML, #30G, 3" C)
		#2J	4(4-350KCML, #30G, 3" C)
		#2K	4(4-350KCML, #30G, 3" C)
		#2L	4(4-350KCML, #30G, 3" C)
		#2M	4(4-350KCML, #30G, 3" C)
		#2N	4(4-350KCML, #30G, 3" C)
		#2O	4(4-350KCML, #30G, 3" C)
		#2P	4(4-350KCML, #30G, 3" C)
		#2Q	4(4-350KCML, #30G, 3" C)
		#2R	4(4-350KCML, #30G, 3" C)
		#2S	4(4-350KCML, #30G, 3" C)
		#2T	4(4-350KCML, #30G, 3" C)
		#2U	4(4-350KCML, #30G, 3" C)
		#2V	4(4-350KCML, #30G, 3" C)
		#2W	4(4-350KCML, #30G, 3" C)
		#2X	4(4-350KCML, #30G, 3" C)
		#2Y	4(4-350KCML, #30G, 3" C)
		#2Z	4(4-350KCML, #30G, 3" C)
		#2AA	4(4-350KCML, #30G, 3" C)
		#2AB	4(4-350KCML, #30G, 3" C)
		#2AC	4(4-350KCML, #30G, 3" C)
		#2AD	4(4-350KCML, #30G, 3" C)
		#2AE	4(4-350KCML, #30G, 3" C)
		#2AF	4(4-350KCML, #30G, 3" C)
		#2AG	4(4-350KCML, #30G, 3" C)
		#2AH	4(4-350KCML, #30G, 3" C)
		#2AI	4(4-350KCML, #30G, 3" C)
		#2AJ	4(4-350KCML, #30G, 3" C)
		#2AK	4(4-350KCML, #30G, 3" C)
		#2AL	4(4-350KCML, #30G, 3" C)
		#2AM	4(4-350KCML, #30G, 3" C)
		#2AN	4(4-350KCML, #30G, 3" C)
		#2AO	4(4-350KCML, #30G, 3" C)
		#2AP	4(4-350KCML, #30G, 3" C)
		#2AQ	4(4-350KCML, #30G, 3" C



AeroRaq Engineering Inc
Engineering Services
8511 Davis Parkway, Suite C6-205
Charlotte, North Carolina 28269
Firm License # C-3509
Phone Number: 704 469 8463

Note:
This drawing is the
property of the firm,
AeroRaq Engineering.
Reproduction in part or in
whole is forbidden
without written
permission.



Revisions	
No.	Date

Make Up Air Upgrade
Cleveland Community College
137 South Post Rd.
Shelby, North Carolina 28152

COPYRIGHT

Project No:
01-2025015

Scale: N/A

Date: 09-16-2025

Title: Electrical Details

E3.1