



# HVAC UPGRADES TO RH FULMER MIDDLE SCHOOL

1614 Walterboro Street  
West Columbia, SC 29170

Solicitation

Mandatory Pre-bid: 02/12/2019 at 10:00 a.m. EST.

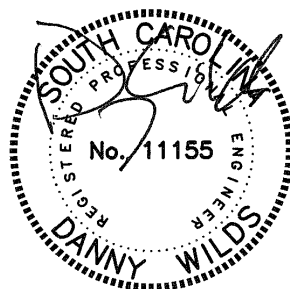
Pre-Bid Location: Lexington County School District Two  
Maintenance Office (Behind Airport High School)  
1631 Walterboro Street  
West Columbia, SC 29169

Bid Due: 02/20/2019 at 2:00 p.m. EST

Lexington School District Two  
Procurement Office  
715 Ninth Street  
West Columbia, S.C. 29169

## **Mechanical Design, Inc.**

4403 Broad River Road  
Columbia, S.C. 29210  
(803)-731-9834



## **SUMMARY OF WORK**

### **Description of work:**

Replace existing Roof Mounted Gas Package Units (GP-1-8) at RH Fulmer Middle School.

### **Demolition:**

Contractor shall provide the demolition and removal of all materials, conduits, wiring, piping and appurtenances as indicated on the drawings, including A/C units, ductwork, and air handler as required and/or directed by Engineer. Disposal of all removed materials shall be included. The Owner shall reserve the right to retain all materials prior to removal from site.

### **Contractor Use of Premises:**

During construction the Contractor shall have use of the area indicated on the drawings for construction operations, including use of the site. The Contractor's use of the premises is limited only by the Owner's right to perform construction operations or employ separate Contractors on portions of the project.

Confine operations to areas within Contract limits. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

Keep driveways and entrances clear at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize requirements for storage of materials.

### **Schedule of work:**

The existing facilities will be vacated during demolition and installation of equipment. All disruption to services shall be scheduled in advance with the Owner prior to start of construction. Contractor shall coordinate the availability of products and equipment on the site prior to any demolition or removal of service.

### **Construction Staging Area:**

The Contractor will be assigned an area to be used for construction staging, storage of equipment on site, area for parking of temporary offices and/or supply trailers and area for parking of construction vehicles. Contractor shall provide temporary fencing with lockable gates for security.

### **SPECIAL NOTE PERTAINING TO ALL DIVISIONS OF THESE SPECIFICATIONS:**

Mechanical Design, Inc., will act as the Owner's agent during the bidding and construction phases. All references in these specifications indicating to be approved by Architect or to be performed by the Architect will be performed by Mechanical Design, Inc.

END OF SECTION

## **TERMS AND CONDITIONS**

Unless otherwise modified, the following terms and conditions will apply to the HVAC services rendered as specified herein and as shown on the drawings. Bids must be held firm and may not be withdrawn for sixty (60) days after the bid opening.

### **Services to be Provided**

The Contractor shall provide services as set forth in their bid and in accordance with the terms identified herein. The services provided will be performed on behalf of and solely for the Lexington School District Two and any information, tests, reports, correspondence, and conclusions shall not be released to other parties unless authorized by the Lexington School District Two or in accordance with any applicable state or federal law.

### **Billing and Payment**

Lexington School District Two will pay the Contractor for services performed in accordance with the bid documents and signed Agreement (see Application for Payment). Lexington School District Two reserves the right to request substantiating information on any bill submitted. Lexington School District Two will, within 10 days after approval of an invoice requesting payment, either indicate the approval of payment and process the invoice or indicate to the Contractor in writing, the reason for refusing to approve said invoice. In the later case, the Contractor will make the necessary corrections and resubmit the invoice. Lexington School District Two will, within 30 days of an approved invoice, pay the amount to the Contractor.

### **Court Litigation and Waiver of Jury Trial**

Notwithstanding the existence of any provision for arbitration of disputes in the contract or any legislation providing for arbitration, any dispute arising under this contract shall not be submitted to arbitration and the parties shall be left to the remedies at law. It is further expressly agreed that both parties waive and relinquish their right to a trial by jury of any dispute arising out of this contract. The intent of the parties is not to have a jury decide any aspect of any dispute which may arise under this contract.

### **Mediation**

All claims, disputes or other matters in question between the parties to this Agreement arising out of or relating to this Agreement or breach thereof shall be submitted to non-binding mediation. On the written notice of either party to the other of the election to submit any dispute under this Agreement to mediation, each party shall designate its representative and shall meet at the Lexington School District Two within ten (10) days after the service of notice. The parties themselves shall then attempt to resolve the dispute within ten (10) days of meeting. Should the parties themselves be unable to agree on a resolution of this dispute, and then the parties shall appoint a third party, who shall be a competent and impartial party and who shall be acceptable to each party, to mediate the dispute. Each party shall pay the fees and expenses of the party mediator and such costs shall be borne equally by both parties. Upon agreement of the parties, either party may waive the first step in the mediation process and appoint a mutually acceptable mediator. Any third party mediator designated to serve in accordance with the provisions of the Agreement shall be disinterested and shall be qualified to evaluate the performance of both parties. This process shall be considered as a condition precedent to moving to court. Equitable Relief Nothing herein shall prevent either party from obtaining a court order enforcing the mediation process or such other temporary or equitable relief until such time that the dispute is settled or finally adjudicated.

**SECTION 01740****WARRANTIES AND BONDS**

Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the owner.

Special Warranties are written warranties required by or incorporated in Contract Documents, to extend time limits provided by standard warranties or to provide greater rights for the Owner.

Requirements for warranties for products and installations that are specified to be warranted, are included in the individual Sections of Divisions-23.

Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and Subcontractors required to countersign special warranties with the Contractor.

Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted Work.

Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

Replacement Cost: On determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefitted from use of the Work through part of its useful service life.

Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit duties, obligations, right and remedies otherwise available under the law, nor shall warranties periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

The Owner reserves the right to refuse to accept Work where a special warranty, or similar commitment is required, until evidence is presented that entities required to countersign commitments are willing to do so.

Submit written warranties to the Architect/Engineer prior to the date certified for Substantial Completion. If the Architect/Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion, submit written warranties on Architect/Engineer's request.

Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.

**END OF SECTION 01740**

WARRANTIES AND BONDS  
*Bid Documents 01-30-2019*

## **PART 1 - GENERAL**

### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. This Section includes administration and procedural requirements for compliance with the 2015 IBC, Chapter 1 Inspections and Chapter 17 Special Inspections.
- C. South Carolina Office of School Facilities (OSF) – “INSPECTION PROGRAM MANUAL”, dated January 14, 2010 or latest edition.

### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Pre-construction Conference: Upon receipt of the “Notice-to-Proceed” and prior to the start of construction, the Architect shall conduct a Pre-construction Conference. It is the responsibility of the Architect to notify the Office of School Facilities (OSF). A representative from OSF along with representatives from the testing company(ies) and the Chapter 1 and Chapter 17 inspection agencies must also be present.
- D. Related Sections include the following:
  - 1. Division 1 Section "Allowances" for testing and inspecting allowances.
  - 2. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections. The special inspector shall continually coordinate with the construction manager for the time and requirements of required inspections.
  - 3. Divisions 2 through 26 Sections for specific test and inspection requirements.

### **1.3 DEFINITIONS**

- A. Agency Approval: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by South Carolina Office of School Facilities (OSF).
- B. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- C. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- D. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- E. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance

characteristics.

- F. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- G. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- H. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- I. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- J. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- K. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- L. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five (5) previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
- C. The special inspector's reports and testing agencies results shall have precedence over reports and test results provided by the contractor.
- D. Where conflict exists between the construction documents and approved shop drawings submittal data, the construction documents shall govern unless the shop drawing/submittal data are more restrictive. All conflicts shall be brought to the attention of the architect.

#### 1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Recognized Agency: For the purposes of this work, only companies utilizing **certified inspectors as designated by the South Carolina Office of the State Engineer or Office of School Facilities** will be accepted for these special inspections. These Companies are listed on their web site however may not be current. Documentation of the individual's certificates scheduled to perform inspections for this project must be submitted for review by the

architect prior to award of this work.

C. Special Inspectors shall keep and distribute records of inspections. The special inspector shall furnish inspection reports to OSF, contractor, architect and owner. Reports shall indicate that work inspected was done in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of OSF and to the architect prior to the completion of the phase of the work. A final report documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted at a point in time agreed upon by the permit applicant and OSF. Prior to the start of work.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

E. Reports: Prepare and submit certified written reports that include, but are not limited to, the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and re-inspecting.

*Sample forms required for use by OSF are indicated in section 3.4 Testing and Inspection Log and Forms located toward the end of this specification.*

F. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and

- with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  2. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed.
  3. Demonstrate the proposed range of aesthetic effects and workmanship.
  4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven (7) days for initial review and each re-review of each mockup.
  5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  6. Demolish and remove mockups when directed, unless otherwise indicated.
- K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 16.



## 1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
  3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies at least Forty Eight (48) hours in advance of time when Work that requires testing or inspecting will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
  6. The contractor shall be responsible for costs of: Re-testing and re-inspection of materials, work and/or products that do not meet requirements of the construction documents and shop drawings/submittal data.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
- D. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with the Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.

- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within thirty (30) days of date established for commencement of the Work the Notice to Proceed.
  - 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### 1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Shall be as listed herein.
- B. Special Tests and Inspections: Conducted by a qualified **special inspector designated by the South Carolina Office of School Facilities (OSF)** as indicated in individual Specification Sections, and as follows:
  - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
  - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
  - 4. Submitting a final report of special tests and inspections at Substantial Completion which includes a list of unresolved deficiencies.
  - 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  - 6. Retesting and re-inspecting corrected work.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.1 ACCEPTABLE TESTING AGENCIES

Acceptable companies shall be as designated by the South Carolina Office of School Facilities (OSF).

##### 3.2 INSPECTIONS REQUIRED CHAPTER 1:

- A. IBC Chapter 1 Inspections
  - 1. Chapter 1 Inspections for this project shall be provided by individuals approved by Office of School Facilities. The required Inspections for this project may include but are not limited to:
    - A. 109.3.4 - Frame inspection (*supplementary steel*).  
**Frame inspection.** Framing inspections shall be made after the roof deck or sheathing, all framing, *fireblocking* and bracing are in place and pipes, chimneys and vents to be concealed are complete and the rough electrical, plumbing, heating wires, pipes and ducts are *approved*.
    - B. 109.3.7 - Energy efficiency inspections. Inspections shall be made to determine compliance with Chapter 13 and shall include, but not be limited to, inspections for: envelope insulation *R*- and *U*-values, fenestration *U*-value, duct system *R*-value, and HVAC and water-heating equipment efficiency.

##### 3.3 SPECIAL INSPECTIONS REQUIRED CHAPTER 17:

###### SPECIAL NOTE:

Chapter 17 inspection is contingent on selection of equipment manufacturer. Manufacturer matching the existing unit will not require any modifications to the existing curb or supplementary support steel.

- A. Field Welding of Structural Steel

Special inspections are required for the welding of structural members or connections for compliance with the approved plans, shop drawings, specifications and Chapter 22 of the IBC. The special inspector shall provide a continuous inspection of, structural welding unless the requirements of the IBC are satisfied, thus allowing periodic inspections. For periodic inspection, the special inspector shall check qualifications of welders at the start of work and then make final inspection of all welds for compliance prior to completion of welding. Single pass fillet welds not exceeding 5/16 inch shall be identified on the drawing. The special inspector shall inspect the equipment, material and technique being employed and verify that the welding is performed by certified welders qualified in the procedure being used. A visual inspection of the completed work shall be made to ensure proper type, size, length and quality of the welds.

### 3.4 TEST AND INSPECTION LOG AND FORMS

- A. Prepare a record of tests and inspections. Include the following:
  - 1. Date test or inspection was conducted.
  - 2. Description of the Work tested or inspected.
  - 3. Date test or inspection results were transmitted to Architect.
  - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.
- C. Maintain all logs, inspection reports and related summary sheets as required by Office of School Facilities (OSF). Samples of the required inspection documentation forms from the OSF Inspection Program Manual (Appendix C – Chapter 1 & Appendix D – Chapter 17) are included at the end of this section for information only. The contractor, testing agency and inspectors are required to be familiar with the required forms as well as the current **“INSPECTION PROGRAM MANUAL”**. This manual along with the current OSF required inspection forms are available on line at the South Carolina Department of Education web site under Office of School Facilities.

### 3.5 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
  - 2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

### 3.6 TESTING AND INSPECTION

- A. Reference related specifications for the minimum level of inspections and testing. Provide additional inspections and testing as necessary to determine compliance with the construction drawings and to satisfy IBC requirements for Chapter 1 Inspections and Chapter 17 Special Inspections.

**END OF SECTION**

**SECTION 23 00 00**

**MECHANICAL; HVAC, GENERAL**

**PART 1 - GENERAL**

- 1.1 The provisions of the GENERAL CONDITIONS OF THE CONTRACT, the SUPPLEMENTARY CONDITIONS, and Section 23 00 00 Mechanical General of the Specifications, apply to the work under this Section to the same extent as if fully included herein.
- 1.2 All material and work shall comply with the National Fire Codes of the NFPA, National and local codes, ICC International Code Council Energy Conservation Code 201509 Edition, the ICC International Code Council Mechanical, Plumbing and Gas Codes 2015 editions.
- 1.3 **CONTRACT DOCUMENTS**
- A. Drawings for work under this Division of the specifications indicate generally the location, arrangement and intent of the systems to be installed. Although they are to some extent diagrammatic, they are to be followed as closely as possible. If due to job conditions, for coordination of other trades, or for other reasons it is found necessary to change the location of items, such changes shall be made without additional cost to the Owner and as reviewed by the Architect. Provide all offsets, fittings, etc., without extra charge.
- B. It is not the intent of these documents to be used as installation drawings nor to include all related services or accessories to place systems in operation. Installation of equipment shall be in strict accordance with the respective manufacturer's recommended instructions. Obtain certified drawings and installation instructions before starting work. The systems shall operate safe, quietly and in the opinion of the Architect, excellent condition.
- 1.4 It is the intent of these plans and specifications to describe a complete and working HVAC system and to prescribe for the complete installation and testing of the equipment and devices specified under other sections of the specifications or on the drawings. Work under this Division of the contract includes all work necessary to make equipment and systems operational while following the details of the drawings and specifications as close as possible. When additional items are required to make systems operational, and are not specifically specified, then items shall be in accordance with the manufacturer's recommendations for the applicable conditions encountered.
- 1.5 **ELECTRICAL CONNECTIONS**
- A. Temperature and equipment control wiring are included under this Division of the contract. All starters not factory-mounted shall be furnished under this Division and installed (including wiring through starters) under "Electrical" Division of the contract. Starters shall be generally furnished by the equipment manufacturer specifically for each piece of equipment. Overload heaters in all starters and in ungrounded conductors are included in this Division of the contract.
- B. Motor starters shall be furnished by the mechanical contractor and turned over to the electrical contractor for mounting and power connections through starter to motor. The contractor shall furnish starters, or combination starter/disconnects as shown on the electrical drawings. Refer to the electrical drawings for the type required for each piece of equipment. Mounting and wiring of starters including wiring to equipment shall be provided under electrical section of the specifications.
- 1.6 **SEISMIC REQUIREMENTS**
- A. All Plumbing and HVAC materials and installation shall comply with the 2015 ICC International Code Council Mechanical Code with the latest revisions for applicable seismic zone protection.
- B. See other sections in Division 23 for more specific specifications. Generally, the seismic requirements are covered in the sections where they apply (example: Seismic restraints for ductwork are in section 23 31 13 Mechanical, Ductwork).

**PART 2 - PRODUCTS**

**2.1 SUBSTITUTIONS**

MECHANICAL, GENERAL

23 00 00 -1  
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- A. All requests for substitutions shall be submitted in writing so as to be received by the Engineer at least ten (10) calendar days prior to bid date and must be granted permission to quote before award of contract.
- B. Requests for approvals shall be submitted in the form of a letter (with one copy minimum) on letterhead of submitting firm. Letter to be addressed to the Engineer and referenced to this job.
- C. Permission to substitute items shall not be construed as authorizing any deviations from the contract documents, unless such deviations are clearly indicated in letter form. Contractor shall be responsible for verifying all dimensions with available space conditions (with provisions for proper access, maintenance, part replacement and for coordination of other trades) for proper services and construction requirements. Contractor to bear any additional costs for required changes in associated items which are directly or indirectly related to a substituted item.

## 2.2 MATERIAL AND EQUIPMENT SUBMITTALS

- A. The Engineer will review and take appropriate action on equipment submittals, product data, samples, and other submittals required by the Contract Documents. Such review shall be only for general compliance with the design and with the information given in the Contract Documents.
- B. All submittals of equipment and materials for this project shall be furnished by the manufacturer's local representative for Mechanical Design, Inc. No submittals will be received where the local representative has not originated or reviewed the submittal prior to submission. All non compliant submittals will be promptly rejected.
- C. Prior to submittal of equipment submittals to the Architect, Contractor shall review and approve equipment submittals. Equipment submittals which have not been reviewed and approved in writing by the Contractor will not be reviewed by the Engineer.
- D. The Contractor shall submit for review by the Architect detailed drawings of all equipment and all material listed in this section. All submittal data shall be bound a hardback binder. Partial submittals will not be reviewed by the Engineer. The Contractor shall furnish six (6) copies of equipment submittals.
- E. Equipment submitted for review shall be detailed, dimensioned drawings or catalog pages showing construction, size, arrangement, operating clearances, performance characteristics and capacities.
- F. Review rendered on equipment submittals shall not be considered as a guarantee of measurements of building conditions. WHERE DRAWINGS ARE REVIEWED, SAID REVIEW DOES NOT MEAN THAT DRAWINGS HAVE BEEN CHECKED IN DETAIL; SAID REVIEW DOES NOT IN ANY WAY RELIEVE THE CONTRACTOR FROM HIS RESPONSIBILITY OR NECESSITY OF FURNISHING MATERIAL OR PERFORMING WORK AS REQUIRED BY THE CONTRACT DOCUMENTS.
- G. The Contractor shall submit equipment submittals for the following materials and equipment for review by the Engineer:
  - Duct System (including closure system)
  - Duct and pipe Insulation (including closure system)
  - Equipment
  - Controls

## 2.3 FINISHES

Contractor shall furnish to Architect color chart, etc. as required for him to select finishes for any piece of equipment, grilles, diffusers, exposed ductwork and piping. Color charts shall be submitted with submittal data. All finishes shall be equivalent to baked enamel unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 SITE CONDITIONS

All bidders shall visit the site and become familiar with all existing conditions before submitting a bid. No extra payments will be made for incidental work not specifically called for but which is necessary for the proper installation of equipment and functioning of the systems as specified in the bid documents. Submission of a bid will be considered as evidence

that the contractor has visited the site of work, and no extra payments will be allowed the Contractor because of extra work made necessary by his failure to do so.

3.2 Contractor shall deliver to owner a complete, fully operational system. All items to be properly lubricated and operate to their full extent upon completion of the project.

3.3 **CONTRACT DOCUMENTS**

After thorough examination of contract documents, Contractor shall bring to attention of Architect prior to bid time any discrepancies, errors or omissions in this Division.

3.4 **CERTIFICATES AND CODES**

Contractor shall deliver to Architect any certificates, permits and licenses as required to comply with all City, County and State applicable laws, ordinances, codes, rules and regulations, including any certificates required by fire department. If any of these items are requested, such items shall be furnished prior to final inspection.

3.5 **WORKMANSHIP**

All work included in this contract shall be performed by skilled people under competent supervision employing the latest and best practices of the various trades involved. All materials and equipment hereinafter specified shall be new and free from flaws and defects of any nature. Work that is not of good quality will require removal and reinstallation.

3.6 **COORDINATION**

- A. No work shall be performed or equipment may be ordered on this project before thoroughly coordinating all space requirements for equipment, ducts, pipes, conduits, etc. with all trades concerned. Establish necessary tie-ins for each trade. No equipment shall be ordered for this project before thoroughly coordinating with all trades the type required for proper installation of equipment in roof, walls and ceiling assembly.
- B. Prior to starting installation, furnish to all trades concerned copies of reviewed shop drawings showings location of equipment, piping, ductwork, etc.
- C. Schedule periodic meetings with other trades before and during installation to avoid conflicts and assure that equipment, piping, ductwork, etc. are installed in the best manner, taking into consideration head-room, maintenance, appearance, replacement and space requirements.
- D. The responsibility for obtaining, cutting, patching, excavating, and backfilling for work under this section of the specifications is included under this section of the specifications.
- E. Contractor shall coordinate the exact size and location of all construction openings with the proper trades preparing the openings and be responsible for obtaining sizes as required. Openings for equipment shall be in accordance with the manufacturer's certified drawings. Lintels shall not be included in this section of the contract.
- F. It shall be the sole responsibility of the Mechanical Contractor to verify and coordinate electrical voltage supplied to all mechanical equipment prior to placing equipment order. Power wiring and mounting of starters and all control components required to install power wiring are not included in this section of the contract. Contractor shall provide adequate wiring diagrams to any trade concerned.
- G. Roof curbs as shown on the Mechanical drawings shall be furnished under this section of the specifications. Curb caps for weather proofing prior to setting of equipment shall also be furnished under this section of the specifications. The installation of roof curbs is not included in this section of the specifications.
- H. Painting of equipment, piping and ductwork for shall be included in this section of the specifications.

3.7 Contractor shall be responsible for the protection and cleanliness of equipment installed under this section of the contract.

3.8 **INSPECTION OF CONCEALED WORK**

Contractor shall notify the Engineer at least three (3) day in advance prior to covering up or concealing any work under this division of the contract. Any work covered or concealed without consent or review of the Engineer shall be exposed for examination at the Contractor's expense.

**3.9 DAMAGES DURING CONSTRUCTION**

Contractor shall be responsible for any costs of repairing any damages caused by this contractor, to the building, building contents, and site during construction and guarantee period.

**3.10 CUTTING AND PATCHING**

Provide all cutting and patching necessary to install the work specified in this section. Provide inserts, sleeves, access panels, supports, etc. Lay out work in advance and establish locations of chases, inserts, sleeves, access panels, etc.

**3.11 EXCAVATION AND BACKFILLING**

- A. Provide all excavating and backfilling for work under this Division of the contract.
- B. Install sewer and water pipes in separate trenches, graded uniformly to provide solid bearing and required fall. Dig bell holes at hubs. Remove rock for one (1) foot below pipe and replace with sand.
- C. Upon completion of tests and inspections, backfill with approved material, placed and tamped to prevent excessive settlement.

**3.12 OWNER INSTRUCTION**

- A. Contractor shall instruct the Owner's representative in complete detail as to proper operation of the overall system. Advise the Owner as to where to order common replacement items. Deliver to the Owner the equipment manufacturer agent's name, address, and telephone number for each piece of equipment.
- B. Provide two copies of a hard back three-ring file folder containing all warranties, catalog data and the manufacturer's standard operating and maintenance instructions for each item of equipment.
- C. The folder shall also contain a maintenance sheet for each piece of equipment, type written by the contractor. Each sheet shall list the maintenance functions to be performed in accordance with the manufacturer's recommendations and the frequency with which each is to be done. Provide columns on each sheet so that they may be dated by maintenance personnel when each individual function is performed. The contractor shall instruct and demonstrate each maintenance function to the Owner's representative.

**3.13 FINAL INSPECTION**

- A. Contractor shall provide all initial balancing that season conditions will allow prior to final inspection.
- B. For final inspection, all construction filters shall be replaced with new filters. All items shall be cleaned thoroughly inside and outside of all dust, dirt, plaster or other foreign material. Repainting of scratched equipment shall be completed.
- C. Contractor shall notify the Architect, Engineer and or construction manager in writing that he has complied with the above items prior to final inspection. In addition the contractor shall furnish a statement prior to OSF inspection the following items are complete:
  - 1. All smoke detectors are installed and working properly.
  - 2. Fire suppression systems, extinguishers are installed and working properly in kitchen hood systems, and any other facilities with special requirements.
  - 3. All penetrations (pipes, conduit, ducts, etc.) in rated walls and/or floor/ceiling assemblies are properly installed using appropriate methods and materials.
  - 4. All required seismic bracing of walls, equipment, pipes and ducts is present and properly installed.
  - 5. All HVAC systems have been tested, balanced, and commissioned per ASHRAE 90.1. A copy of the report will be available at the inspection.
  - 6. Listed assembly details, product data sheets, and approved submittals are available on site.

- D. A mechanic shall be present at final inspection with all tools and instruments required to completely inspect and check measurements required under "Testing and Balancing." Provide a stepladder and keys for control instruments.
- E. Contractor shall indicate in red ink on prints all changes to underground services. Submit print along with other submittals required prior to final inspection.

**3.14 MECHANICAL MAINTENANCE**

- A. Contractor shall assure the proper operation all required preventative maintenance for all equipment and controls provided under this Division of the contract for a period of two (2) years after final completion and acceptance of the work.
- B. Contractor shall receive calls for any problem experienced in the operation of the equipment provided under this Division of the contract. He shall take steps to immediately correct such problems. All equipment that requires repairing shall be immediately serviced and repaired. All parts and labor shall be furnished at no extra cost to the Owner. If emergency service is required beyond regular working hours, the contractor shall furnish such service at no extra charge.
- C. Contractor shall provide quarterly inspections of all equipment and record the findings on a checklist with a copy posted in the main mechanical room. The checklist shall list each piece of equipment specified in this Division of the contract. The checklist shall have a space for check-off for each of the four (4) inspections. This checklist shall be certified by the contractor that each piece of equipment is operating as intended by the manufacturer and that all preventative maintenance has been performed as recommended by the manufacturer and by good and accepted practice.
- D. Contractor shall clean or replace filters as necessary during each quarterly inspection. Filters shall be furnished by the owner.

**3.15 GUARANTEE**

- A. Contractor shall guarantee all equipment, ductwork, piping and any other materials specified under this Division of the contract for a period of two (2) years from the date of project acceptance unless otherwise indicated. Upon failure of any part(s) of the system during the guarantee period, the affected part(s) shall be repaired or replaced promptly by and at the expense of the Contractor.
- B. If any component fails during the regular two year period, then the replacement part(s) shall be given an additional two (2) year guarantee from the time of replacement. This shall continue until the items have given one (1) years satisfactory service.

**3.16 IDENTIFICATION**

Contractor shall identify each piece of equipment (except in finished areas) and each control device with its correct set point. Items shall be identified by name and numerical sequence (RTU-1, etc.). Nameplates shall be 1/16" thick plates with 1/2" high white letters on black background. Nameplates shall be attached securely. No identification shall be done until all painting has been accomplished. Locations for servicing equipment above ceilings shall also be labeled with nameplates attached to the ceiling grid identifying equipment and access location.

**3.17 EQUIPMENT PAINTING**

Contractor shall paint all new equipment (except factory painted equipment), ductwork, piping and any other materials exposed to view. New equipment, pipes, ductwork and other exposed materials shall be completely sanded, primed and repainted where factory paint has been scratched. Paint shall be as recommended by equipment manufacturer. Pipes shall be color coded with colors selected by the Engineer. Devoe, Sherwin Williams, Pittsburg, Glidden or approved equal paints may be used.

**3.18 RECORD DRAWINGS**

- A. Contractor shall maintain on the job site one complete set of drawings for this project. All changes authorized by the Architect and/or Owner as to locations, sizes, etc. of equipment, ductwork, piping and other material shall be



indicated in red ink on the drawings as work progresses.

- B. Contractor shall obtain at his expense, a set of reproducible mylar drawings on which he shall indicate the information outlined above, prior to final inspection. The Architect will make available to the Contractor original drawings of the work to be used to make the reproducible mylar drawings. The final, annotated, reproducible mylar drawings shall be turned over to the Architect at the time of final inspections.

**3.19 UTILITY INTERRUPTIONS:**

Obtain owner's approval for water utility interruptions at least five (5) working days in advance of all scheduled interruptions. Contractor shall arrange work so that interruptions are minimized in number and duration.

**3.20 TEMPORARY AIR CONDITIONING**

- A. The Mechanical Contractor shall coordinate with the General Contractor the requirements for temporary air conditioning of the building for completion of interior finish work prior to substantial completion.
- B. The mechanical Contractor shall schedule his work to provide temporary heating and cooling utilizing the new HVAC system at the request of the General Contractor. Service, maintenance and filter service of the equipment shall be provided by the Mechanical Contractor. The Mechanical contractor shall provide temporary duct filters to maintain a clean duct system during temporary service.
- C. The use of the new HVAC system shall not decrease the equipment or installation warranty as specified herein. All equipment and installation warranties shall begin at substantial completion of work.

**END OF SECTION 23 00 00**

## SECTION 23 05 48

### VIBRATION ISOLATION AND SEISMIC RESTRAINT

#### PART 1 - GENERAL

- 1.1 The provisions of the GENERAL CONDITIONS OF THE CONTRACT, the SUPPLEMENTARY CONDITIONS, and Section 23 00 00 Mechanical General of the Specifications, apply to the work under this Section to the same extent as if fully included herein.
- 1.2 All equipment and materials for this project shall be purchased from and furnished to the contractor by the manufacturer's local representative for Mechanical Design, Inc. No submittals for equipment or materials will be received where the local representative has not originated the submittal data for this project. All non compliant submittals will be promptly rejected.
- 1.3 The seismic supplier shall provide a project site visit review, certification of installation of seismic components during construction and furnish a written report after installation of seismic components are complete. Site visit review and certification letter shall be certified by a registered professional engineer in the employ of the seismic equipment manufacturer with a minimum 5 years experience and licensed in the project's jurisdiction. The certification letter shall be furnished on the manufacturer's letterhead.
- 1.4 See "EQUIPMENT ISOLATION AND SEISMIC SCHEDULE" at the end of this section for applicable specification requirements.
- 1.5 All mechanical equipment 3/4 HP and over listed in the Vibration Isolation / Seismic schedule shall be mounted on vibration isolators to prevent the transmission of objectionable vibration and vibration induced sound to the building structure. All isolation materials, flexible connectors and seismic restraints shall be of the same manufacturer.
- 1.6 Install full line size flexible pipe connectors at the inlet and outlet of each pump, cooling tower, condenser, chiller, coiling connections and where shown on the drawings. All connectors shall be suitable for use at the temperature, pressure, and service encountered. Flexible connectors shall not be required for suspended in-line pumps.
- 1.7 Unless otherwise specified, all mechanical, electrical, and plumbing equipment, pipe, and duct shall be restrained to resist seismic forces. Restraint devices shall be designed and selected to meet the seismic requirements as defined in the latest issue of the IBC or local jurisdiction building code.
- 1.8 Seismic restraint shall not be required for the following:
  - A. Hanging, wall mounted, and flexibly supported mechanical, plumbing and electrical components that weigh 20 pounds (89 N) or less, where  $I_p = 1.0$  and flexible connections are provided between the components and associated duct work, piping and conduit.
  - B. Piping supported by individual clevis hangers where the distance, as measured from the top of the pipe to the supporting structure, is less than 12 inches for the entire pipe run and the pipe can accommodate the expected deflections. Trapeze or double rod hangers where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run.
  - C. High deformability piping (steel, copper, aluminum with welded, brazed, ground, or screwed connections) designated as having an  $I_p = 1.5$  and a nominal pipe size of 1 inch (25 mm) or less where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment. Note, any combination of piping supported on a trapeze where the total weight exceeds 10 lb/ ft. must be braced.
  - D. High deformability piping (steel, copper, aluminum with welded, brazed, ground, or screwed connections) and limited deformability piping (cast iron, FRP, PVC) designated with an  $I_p = 1.0$  and a nominal pipe size of 1 inch and less in the mechanical equipment room, or 2" and less outside the mechanical equipment room.
  - E. PVC or other plastic or fiberglass vent piping.
  - F. HVAC ducts suspended from hangers that are 12 inches or less in length from the top of the duct to the supporting

structure and the hangers are detailed to avoid significant bending of the hangers and their connections. Duct must be positively attached to hanger with minimum #10 screws within 2" from the top of the duct.

HVAC duct with an  $I_p = 1.5$  that have a cross-section area less than 4 square feet. HVAC ducts with an  $I_p = 1.0$  that have a cross sectional area of less than 6 square feet.

- G. Equipment items installed in-line with the duct system (e.g, fans, heat exchangers and humidifiers) with an operating weight less than 76 pounds . Equipment must be rigidly attached to duct at inlet and outlet.
  - H. Manufacturer of vibration and seismic control products shall provide piping, ductwork and equipment isolation systems and seismic restraints as scheduled or specified with installation instructions and shop drawings for all materials supplied under this section of the specifications.
- 1.9 Submittals shall include calculations to determine restraint loads resulting from seismic forces presented in local building code or IBC, Chapter 16 latest edition. Seismic calculations shall be certified & stamped by an engineer in the employ of the seismic equipment manufacturer with a minimum 5 years experience and licensed in the project's jurisdiction. Provide calculations for all floor or roof mounted equipment, and all suspended or wall mounted equipment 20lbs or greater.
  - 1.10 Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.
  - 1.11 The isolators and seismic restraint systems listed herein are as manufactured by Amber / Booth, Mason Industries, Kinetics, or approved equals which meet all the requirements of the specifications, are acceptable. Manufacturer must be a member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).
  - 1.12 Steel components shall be cleaned and painted with industrial enamel. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
  - 1.13 All isolators, bases and seismic restraints exposed to the weather shall utilize cadmium plated, epoxy coat or PVC coated springs and hot dipped galvanized steel components. Nuts, bolts and washers may be zinc-electroplated. Isolators for outdoor mounted equipment shall provide adequate restraint for the greater of either wind loads required by local codes or withstand a minimum of 30 lb. / sq. ft. applied to any exposed surface of the equipment.
  - 1.14 Provide shop drawings indicating location of all cable restraints required for pipe and ductwork. Drawings must be stamped by manufacturer's registered professional engineer. Mechanical, electrical and plumbing equipment manufacturers shall provide certification that their equipment is capable of resisting expected seismic loads without failure. Equipment manufacturers shall provide suitable attachment points and/or instructions for attaching seismic restraints.

## PART 2 - PRODUCTS

### 2.1 VIBRATION ISOLATORS

- A. Specification W: a pad type mounting consisting of two layers of ribbed elastomeric pads with a ½" poro-elastic vibration absorptive material bonded between them. Pads shall be Amber / Booth Type NRC.
- B. Specification A: an elastomeric mounting having a steel baseplate with mounting holes and a threaded insert at top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric material. Mountings shall be designed for approximately ½" deflection, and incorporate a steel seismic snubber with all directional restraint. Mountings shall be Amber/Booth Type SRVD.
- C. Specification D: an elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment and an elastomeric isolation element designed for approximately ½" deflection. Hangers shall be Amber/Booth Type BRD.
- D. Specification E: a combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment, coil spring, spring retainers and

elastomeric element designed for approximately 1/2" deflection. The spring shall be designed for a minimum  $k_x/k_y$  of 1.0. Spring hangers shall be Amber/Booth Type BSRA.

- E. Specification F: a set (two or more) of spring thrust resisting assemblies, which consist of coil springs, spring retainer, isolation washer, angle mounting brackets, and elastomeric tubing for isolating thrust resistor rod from fan discharge. Thrust restraints shall be Amber / Booth Type TRK.
- F. Specification SB: a unitized adjustable open spring isolator and a welded steel housing designed to resist seismic forces in all directions. Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer to protect equipment. Restraints shall allow a maximum of 1/4" movement before engaging and shall allow for the spring to be changed if required. Isolator shall be a stable spring with a minimum  $k_x/k_y$  of 1.0. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. Nuts and bolts shall be zinc-electroplated to prevent corrosion. Bolting equipment to isolator with bolts smaller than main adjusting bolt will not be allowed. Baseplate shall provide means for bolting to the structure. Entire assembly shall be rated to exceed the applied seismic load. Mountings shall be Amber/Booth Type SWSR.

## 2.2 BASES

- A. Specification G: a welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. The steel members shall be adequately sized to prevent distortion and misalignment of the drive, and specifically, shall be sized to limit deflection of the beam on the drive side to 0.05" due to starting torque. Snubbers to prevent excessive motion on starting or stopping shall be furnished if required; however, the snubbers shall not be engaged under steady running conditions. Bases shall be Amber/Booth Type SFB.
- B. Specification H: a welded WF (main member) structural steel base for increasing rigidity of equipment mounted thereon or for unitizing belt driven fans. Fan bases shall have holes drilled to match fan and located to provide required center distance between fan and supplied NEMA standard motor slide rails. The steel members shall have minimum depth of 1/12" of the longest span, but not less than 6" deep. Junior beams and junior channels shall not be used. Cross members shall be provided where necessary to support the equipment or to prevent twisting of the main members. Where height restrictions prevent the use of members having a depth of 1/12 of the longest span, beams of less depth may be used provided they have equal rigidity. Provide height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Bases shall be Amber/Booth Type WSB.
- C. Specification J: a concrete inertia base consisting of perimeter structural steel concrete pouring form (CPF), reinforcing bars welded in place, bolting templates with anchor bolts and height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. The perimeter steel members shall have a minimum depth of 1/12 of the longest span, but not less than 6" deep. The base shall be sized with a minimum overlap of 4" around the base of the equipment and, in the case of belt-driven equipment, 4" beyond the end of the drive shaft. Fan bases are to be supplied with NEMA standard motor slide rails. The bases for pumps shall be sized to support the suction elbow of end suction pumps and both the suction and discharge elbows of horizontal split-case pumps. The bases shall be T-shaped where necessary to conserve space. Inertia bases shall be Amber/Booth Type CPF.

## 2.3 SEISMIC RESTRAINTS:

- A. Specification SL: a restraint assembly for floor mounted equipment consisting of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and to the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a minimum 1/4" thick resilient elastomeric pad to protect equipment. Restraints shall be field adjustable and be positioned for 1/4" clearance as required to prevent interference during normal operation. Restraint assembly shall have minimum rating of 2 times the catalog rating at 1 G as certified by independent laboratory test. Restraint shall be Amber/Booth Type ER.
- B. Specification SC: a restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable must have Underwriters Laboratories listed certified break strength, and shall be color-coded for easy field verification. Secure cable to structure and to braced component through bracket or stake eye specifically designed to exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per AISI Manual for structural applications of steel cables and ASTM A630. Break strengths must be per ASTM E-8 procedures. Safety factor of 1.5 may be used when prestretched cable

is used with end connections designed to meet the cable break strength. Otherwise safety factor 3.76 must be used. Cables shall be sized for a force as listed in section 1.3. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be type LRC.

#### 2.4 ROOFTOP UNIT CURBS AND ISOLATION SYSTEMS

- A. Specification X: Non isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough provide continuous perimeter support for rooftop unit. Curb must provide means to positively anchor to concrete deck, or bolt or weld directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. Curb shall use minimum 16 gage galvanized steel and shall be designed with cross bracing required to withstand the greater of seismic forces or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Seismic curbs shall be Amber/Booth Type RTC. Steel shall be primed with metal etching primer.
- B. Specification Z: Seismically rated rooftop isolation curb system that is flashed into roofing membrane. Standard unit curb will not be used. Air and watertight upper curb shall have a neoprene sponge seal at the top and be rigid enough provide continuous perimeter support for rooftop unit. The upper curb shall be supported by type C isolators welded or bolted to continuous structural support which is positively anchored to concrete deck or bolted or welded to the structure to withstand seismic loading. An EPDM nylon reinforced air tight weatherproof seal shall consolidate the upper and lower curbs. Weatherproof access doors shall be provided at each isolator to allow isolator adjustment. Isolation curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. Isolation curb shall use minimum 16 gage galvanized steel and shall be designed with cross bracing required to withstand the greater of seismic forces or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Isolation curbs shall be Amber/Booth Type RTIC. Steel shall be primed with metal etching primer. Steel exposed to view or outdoors shall be primed and painted to match unit color.

#### 2.5 FLEXIBLE PIPE CONNECTIONS

- A. Specification K: Water Service: For flanged connection – a double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225 degrees F. Connectors shall have minimum movement capabilities of 1.77" compression, 1.18" lateral and 1.18" extension. Connectors shall provide a minimum 35 degree angular movement up to 6", minimum 30 degree up to 12" and minimum 20 degree up to 24". Spring loaded control units shall be furnished to limit movement to within allowables. Amber/Booth Type 2600.
- B. Water Service: For threaded type – A double spherical rubber hose connector, minimum 8" long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8" compression, 7/8" lateral, 1/4" extension and 20 degree angular through 1-1/4", 13 degree through 2", and 9 degree through 3". Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225 degree F. Connectors shall have cable control units to limit extension to 1/4". Amber/Booth Type 2655.
- C. Specification L: Steam and Condensate Service:  
For flanged connection – a metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Live lengths shall conform to hose minimum length to absorb thermal and dynamic movement. Hose axis must be perpendicular to pipe movement. Amber/Booth Type SS-FP or SS-FW. For threaded connections - a metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Amber/Booth Type SS-PM.
- D. Air Compressor Service:  
For flanged connection – a flanged metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Connector shall be double braided with a minimum live length equal to four times the diameter. Connector shall be installed with the long axis perpendicular to the motion to be absorbed. Amber/Booth Type SS-FP (Special). For threaded connection – a metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Connector shall be double braided and have a minimum live length equal to four times

the diameter. Connector shall be installed with the long axis perpendicular to the motion to be absorbed. Amber/Booth Type SS-PM (special).

### **PART 3 - EXECUTION**

3.1 Isolator and seismic restraints shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 3/4 hp and over per the isolation schedule and these specifications.

#### **3.2 PIPING ISOLATION**

Horizontal Pipe Isolation: all HVAC pumped water, steam, pumped condensate, glycol, and refrigerant piping size 1 1/4" and larger connected to isolated equipment isolated. This piping shall be isolated for the first 3 support locations from externally isolated equipment with specification E hangers or specification SB or SX floor mounts with the same deflection as equipment isolators (max 2"). Pipe Riser Isolation: All variable temperature vertical pipe risers 1-1/4" and larger, riser piping requiring isolation or where specifically shown and detailed on riser drawings shall be fully supported by specification B mounts with precompression plates. Steel spring deflection shall be .75 inch minimum except in those locations where added deflection is required due to pipe expansion and contraction. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed. Riser supports shall be Amber/Booth Type SWP.

#### **3.3 DUCT ISOLATION:**

Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type E hangers or type SB (SX) floor mounts.

#### **3.4 INSTALLATION**

- A. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary support during installation or shipping.
- B. Locate isolation hangers as near the overhead support structure as possible. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of 1inch clearance below base will result when supported equipment has been installed and loaded for operation.
- C. Seismic Rated roof curbs shall be installed directly to building structural steel or concrete roof deck. Installation on top of steel deck or roofing material is not acceptable. Shimming of seismic rated curbs is not allowed. Housekeeping Pads shall be constructed and installed per ASHRAE's "A Practical Guide to Seismic Restraint". They shall be a minimum of .5" thicker than the maximum embedment required of any anchor but not less than 6". They shall be sized to provide minimum edge distances for all installed anchors. They must be anchored to the floor structure in an approved manner.

#### **3.5 APPLICATION OF SEISMIC RESTRAINTS**

- A. All floor mounted isolated equipment shall be protected with type SB or type C unitized isolator and restraint or with separate type SL restraints (minimum of 4. Floor mounted non-isolated equipment shall be protected by properly sized anchor bolts with elastomeric grommets provided by the isolation manufacturer All suspended equipment and vessels shall be protected with specification SC restraints. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation.
- B. All piping shall be protected in all planes by SC restraints, designed to accommodate thermal movement as well as restrain seismic motion. (spring-loaded control rods should be used on flexible connectors in system). Tanks and vessels connected in line to piping shall be restrained independently. Locations shall be as determined by the isolator/seismic restraint supplier.
- C. Where riser pipes pass through cored holes, core diameters to be a maximum of 2" larger than pipe O.D.

including insulation. Cored holes must be packed with resilient material or fire stop as provided by other sections of this specification or local codes. No additional horizontal seismic bracing is required. Restrained isolators type C or SB shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints. For risers in pipe shafts, specification SC cable restraints shall be installed at each level in a manner that does not interfere with thermal movement.

**3.6 DUCT WORK**

Duct work shall be protected in all planes by SC restraints. Locations shall be determined by the isolator supplier.

**3.7 EQUIPMENT ISOLATION AND SEISMIC SCHEDULE**

<b>EQUIPMENT TAG</b>	<b>COMPONENT Ip</b>	<b>ISOLATION SPEC.</b>	<b>SEISMIC REST, SPEC.,</b>	<b>ISOLATION DEFL.</b>
Air Handling Units	1.0	Internal By Manuf.	Note 1	2"
Air Handling Units (Flr)	1.0	Spec SB/Spec K	Spec SB	1"
Fan VAV Term.	1.0	Spec D	Spec SC	.5"
Inline Fans	1.0	Spec D	Spec SC	1"
Package Units (On Grade)	1.0	Spec W/Spec K	Note 1	.15"
Package Units (On Roof)	1.0	Spec X/Spec Z	Note 4	.15"
Unit Heaters (Susp)	1.0	None	Spec SC	N/A
Cabinet Heaters (Susp)	1.0	Spec D	Spec SC	.5"
Kitchen Hoods	1.0	None	Spec SC	N/A
Wshp (Floor)	1.0	Spec SB	Spec SB	1"

Notes

1. Anchor bolts for non-isolated and internally isolated equipment shall be sized by the seismic restraint supplier. If required, Spec. SL snubbers or Spec. SC cable kits shall be provided.
2. Roof curbs provided by others must be certified by a professional engineer for the required seismic loads.
3. All Life Safety equipment, and all equipment in Seismic Use Group III buildings shall have Ip = 1.5.
4. Provide vibration isolation roof curbs for all units 10 tons and larger.

**\*See architectural and structural for applicable projects seismic factors.**

**END OF SECTION 23 05 48**

**SECTION 23 05 93**

**TESTING ADJUSTING AND BALANCING**

**PART 1 - GENERAL**

- 1.1 The provisions of the GENERAL CONDITIONS OF THE CONTRACT, the SUPPLEMENTARY CONDITIONS, and Section 23 00 00 Mechanical General of the Specifications, apply to the work under this Section to the same extent as if fully included herein.
- 1.2 All equipment and materials for this project shall be purchased from and furnished to the contractor by the manufacturer's local representative for Mechanical Design, Inc. No submittals for equipment or materials will be received where the local representative has not originated the submittal data for this project. All non compliant submittals will be promptly rejected.
- 1.3 Work under this section includes the testing, adjusting and balancing air and water systems in all heating, ventilating and air conditioning systems. The results of all tests, adjustments and balancing shall be submitted to the Architect for approval. The testing and balancing report shall be complete and available on site for review prior to final inspection by the Office of School Facilities (OSF).
- 1.4 Other sections of the specification are a part of this section. Refer to all other sections for a complete description of the work.

**1.5 COMMISSIONING**

The testing and balancing contractor in conjunction with the mechanical contractor and controls contractor shall submit a statement to the Commissioning Authority that check test and start-up has been successfully completed and that all equipment, systems and controls are complete and ready for functional performance testing.

- 1.6 Testing and balancing of the HVAC system is defined as the optimization of the installed system. The equipment schedule is used for equipment selection only. Industry standards of +/-10% are considered to be benchmarks and will not be used as an absolute requirement for final acceptance of the project. Approval of the final report will be the sole responsibility of the design engineer.

**1.7 TESTING AND BALANCING AGENCY**

- A. All work shall be performed by an independent Test and Balance Agency. Testing, adjusting and balancing work shall be the firm's sole source of income. All work shall be under the direct supervision of a project manager who is qualified for testing and balancing the hydronic and air performance of heating, air conditioning, and ventilating systems.
- B. The testing and balancing contractor will test and balance the systems according to NEBB standards. The T&B contractor will provide the mechanical contractor with a written list of all project deficiencies and copy the engineer via fax. The T&B contractor will work with the engineer and contractor to insure that any and all deficiencies are adequately addressed prior to submission of the final report. The engineer will be provided with a T&B summary prior to submission of the final report. The T&B Contractor shall notify the engineer and contractor immediately of any deficiencies which impede balancing and any inability to meet the specified requirements.
- C. The design engineer may request verification of data at any time during or after the T&B process. The test, balancing and adjusting shall be performed as many times as required to prove project requirements have been met. If requested by the Engineer, tests shall be performed in his presence
- D. The Testing and Balancing firm will be certified by NEBB and have a minimum of ten years experience in testing and balancing. Acceptable firms to perform testing and balancing on this project are:

Palmetto Air and Water (864) 877-6832  
Carolina Air & Water Balancing, Inc. (803) 776-0568  
Hilton Services. (803) 345-5994  
Vapor Test and Balance (803) 604-9427



### 1.8 RESPONSIBILITY OF OTHERS

- A. Mechanical Contractor- The mechanical contractor is responsible for installing the systems per the plans and specification. The mechanical contractor is also responsible coordinating work between the T&B and Control contractor. All system deficiencies will be corrected/optimized prior to the submission of the T&B report. The mechanical contractor will supply the test and balance contractor with accurate drawings, submittals, and support required to optimize the system(s).
- B. Control Contractor- The control contractor shall work closely with the T&B contractor during testing and balancing to insure proper operation of the control system. The control contractor will functionally check the controls prior to the T&B process. The T&B process will not begin until the control system has been checked and approved by the control contractor. The control contractor will furnish any software required to test and balance the system(s).

### 1.9 INSTRUMENTS

Instruments used shall be of high quality and as recommended by AABC or NEBB for the application. Instruments shall be properly calibrated and certified within the last six months.

### 1.10 ACCURACY

The balancing firm shall warrant, solely that the system will be set to the values as established by the drawings and specifications and also adjust to minimize drafts in all areas.

### 1.11 CHANGES

Any changes that are required for the final balancing results as determined by the balancing firm shall be provided under this section of the specifications. Such changes shall include, but not limited to, changing of pulleys, belts, dampers or adding dampers or access panels.

## PART 2 - PRODUCTS

### 2.1 SUBMITTALS:

- A. Prior to acceptance of the systems by the Owner, submit to the Engineer for his review, a written testing, adjusting and balancing report, in triplicate, contained in a hard-backed three ring notebook.
- B. All reports, forms and data sheets shall generally be the standards of AABC or NEBB.

## PART 3 - EXECUTION

### 3.1 BALANCING PROCEDURE:

- A. Before starting air balance, check the following items:
  - 1. Air filters to assure cleanliness and position
  - 2. All fans for proper belt tension, alignment and rotation
  - 3. Fan and motor lubrication
- B. Measure supply air volumes by means of the duct traverse method, taking a minimum of 16 readings. Seal duct access holes with snap-in plugs. The use of duct tape to seal access holes will not be allowed.
- C. Adjust balancing dampers for required branch duct air quantities. Dampers shall be permanently marked after air balance is complete.
- D. The total air delivery in any particular fan system shall be obtained by adjustment of the particular fan speed or air valve set point. The drive motor of each fan shall not be loaded over the corrected full load amperage rating of the motor involved.

**3.2 ADJUSTING AND BALANCING**

A. Adjust, balance, record and submit as previously specified, for each of the following:

1. Grilles and Diffusers:

<i>Fan Mark</i>	<i>Room if Applicable</i>	<i>Design CFM</i>	<i>Measured CFM</i>
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2. Rooftop Units:

- a. Supply Air Dry Bulb Temperature
- b. Total CFM
- d. Return Air CFM
- e. Outside Air CFM
- f. Total Static Pressure
- g. External Static Pressure
- h. Nameplate Data
- l. Actual Motor Amperage and Voltage
- j. Fan RPM

**3.3 SUPPLY DUCT LEAKAGE TESTING**

- A. The installed supply duct system shall be tested at ½" operating pressure.
- B. The air leakage at the test pressure shall be measured by a calibrated orifice type of flow meter. Total allowable leakage of the system shall not exceed 5% of the fan capacity of the system.
- C. If the system is tested in sections, the leakage rates shall be added to give the performance of the whole system.
- D. The supply duct system shall be tested with spin-in take-offs in place. Provide air bags or other temporary means of capping take-offs during leak test.
- E. Duct systems not passing the leak test shall be sealed and re-tested.
- F. The orifice flow measurement device must have been individually calibrated against a primary standard, and this calibrated curve permanently attached to the orifice tube assembly.
- G. Certificate of leakage compliance shall be submitted by the testing, adjusting and balancing firm to the Engineer for his files.

**END OF SECTION 23 05 93**

**SECTION 23 07 00**  
**MECHANICAL, INSULATION**

**PART 1 - GENERAL**

- 1.1 The provisions of the GENERAL CONDITIONS OF THE CONTRACT, the SUPPLEMENTARY CONDITIONS, and Section 23 00 00 Mechanical General of the Specifications, apply to the work under this Section to the same extent as if fully included herein.
- 1.2 All equipment and materials for this project shall be purchased from and furnished to the contractor by the manufacturer's local representative for Mechanical Design, Inc. No submittals for equipment or materials will be received where the local representative has not originated the submittal data for this project. All non compliant submittals will be promptly rejected.
- 1.3 **INSULATION**

All insulation material shall have a fire hazard classification not to exceed flame spread of 25 and smoke developed rating of 50, as listed by Underwriters Laboratories and acceptable under NFPA standards. This is to apply to the complete system and to the composite insulation with jacket or facings, vapor barrier, tapes, mastic and fittings.

**PART 2 - PRODUCT**

**2.1 DUCT INSULATION/LINER**

- A. All ducts shall be insulated with flexible glass fiber blanket duct wrap except where noted to be double wall duct or otherwise specified.
- Ducts located within the building thermal envelope:* Insulation for sheet metal ducts shall be 2.33 " thick Johns Manville Microlite XG commercial grade formaldehyde-free fiber glass duct wrap or equal. Insulation shall be .75lb. density (installed R-6.5 min) with FSK vapor barrier. Insulation shall meet the UL 25/50 smoke develop/flame spread requirements.
  - Ducts located outside the building thermal envelope:* Insulation for sheet metal ducts shall be 3 " thick Johns Manville Microlite XG commercial grade formaldehyde-free fiber glass duct wrap or equal. Insulation shall be .75lb. density (installed R-8.3 min) with FSK vapor barrier. Insulation shall meet the UL 25/50 smoke develop/flame spread requirements.
- B. Acoustical duct liner shall be 1" thick Armacell Coilflex (R-4 min with EPA Registered Anti-microbial) closed cell liner.
- C. Ductwork shall be constructed as job progresses and not in advance to prevent damage to ductwork on site. Ductwork shall not be prefabricated more than 1 week in advance of installation.

**PART 3 - EXECUTION**

**3.1 INSULATION FIRM**

All insulation work shall be performed by a franchised insulation firm. All insulation shall be installed in a workmanlike manner by qualified workers in the regular employ of the insulation firm.

**3.2 DUCT INSULATION**

- A. All insulation work shall be performed by a franchised insulation firm. All insulation shall be installed in a workmanlike manner by qualified workers in the regular employ of the insulation firm.
- B. All sheet metal supply, return, fittings, and outside air ducts shall be insulated with 2" ductwrap except where specified otherwise herein. Adhere insulation on ducts to metal with 4" strips of insulation bonding adhesive at 8" centers. Secure insulation on ducts over 24" wide with weld pins and clip washers spaced not more than 15" o.c., to bottom of duct. Staple insulation at all seams with outward clinch staples and vapor sealed with a 3" piece of Glasfab coated

completely with a flame retardant LEED approved mastic. This application also applies at connections to

pre-insulated flexible ductwork. **Duct tape and pressure sensitive foil tapes will not be allowed.** Use of tapes will require complete removal and repair of duct insulation prior to re-sealing of joints and seams.

- C. Supply, return, fittings, exhaust and outside air duct insulation requirements shall be as follows:
  - 1. Rooftop Units
    - all supply and return ducts from rooftop units with supply ducts located above ceilings shall be single wall low pressure sheet metal ducts wrapped with 2.33" fiberglass ductwrap insulation

**END OF SECTION 23 07 00**

**SECTION 23 31 13**

**MECHANICAL, DUCTWORK**

**PART 1 - GENERAL**

- 1.1 The provisions of the GENERAL CONDITIONS OF THE CONTRACT, the SUPPLEMENTARY CONDITIONS, and Section 23 00 00 Mechanical General of the Specifications, apply to the work under this Section to the same extent as if fully included herein.
- 1.2 All ductwork shall meet job conditions and after coordinating with all trades. Follow duct dimensions indicated on drawings as closely as possible. Provide offsets, vary shape or alter run if required to meet structural or other interferences. Where shape of duct is varied, alter dimensions to provide equal static pressure drop per unit length.
- 1.3 Obtain copies of applicable "Sheet Metal and Air Conditioning Contractors National Association, Inc." (SMACNA) Manuals, latest edition, and keep one copy of each on job site.
- 1.4 Ductwork shall be air tight, smooth on inside and neatly finished on outside. Details of support, construction and materials not specified herein to be in accordance with recommendations of SMACNA.
- 1.5 Construct ductwork as job progresses and not in advance. Ductwork shall not be prefabricated more than 1 week in advance of installation.
- 1.6 No ductwork shall be fabricated or installed until all space requirements have been thoroughly coordinated with all other trades.

**PART 2 - PRODUCT:**

**2.1 SHEET METAL DUCTWORK**

Sheet metal ductwork shall be in accordance with SMACNA Manual "Low Velocity Construction Standards," latest edition.

**2.2 FLEXIBLE DUCTWORK**

Fiberglass flexible round duct shall be a minimum of 1" thick Owens-Corning or equal by Genflex. The product shall bear a U.L. 181 Class 1 Air Duct label.

**2.3 LOW PRESSURE DUCTWORK**

- A. Sheet metal ductwork shall be in accordance with SMACNA Manual "Low Velocity Construction Standards," latest edition.
- B. Fiberglass flexible round duct shall be a minimum of 1" thick Owens-Corning or equal by Genflex. The product shall bear a U.L. 181 Class 1 Air Duct label.

**PART 3 - EXECUTION:**

**3.1 DUCTWORK**

- A. All supply air ductwork from air handling units shall be low pressure duct. Installation shall be in strict accordance with SMACNA.
- B. All return, exhaust and outside air ducts shall be low pressure sheet metal.
- C. All turns greater than 45 degrees shall be made with turning vanes. Turning vanes shall be single vane type installed on runners.
- D. Support horizontal ducts with 1" galvanized hanger straps spaced not more than eight (8) feet apart, at every transverse joint and at changes in direction.

- E. Duct sizes indicated on plans are interior dimensions. Increase metal duct sizes as required for acoustical or interior insulation.
- F. Construct, brace, and support ducts in manner that they will not sag nor vibrate when fans are operating at minimum speed and capacity.
- G. Provide 1" diameter test slots with cover for insertion of thermostat or test instruments at all locations required to perform operations required under Section 15050.
- H. Provide duct access doors to afford easy access to entering air side of items requiring maintenance or inspection (such as fire dampers, etc.). Doors to be of ample size for service required.
- I. Protect all fan and duct openings from dirt and rubbish during construction. Clean system to be delivered to owner.
- J. All interior portions of ductwork visible through grilles or diffusers shall be painted with flat black paint.
- K. Each section of flexible round duct shall have locking worm clamps designed to connect to duct take-off fittings and terminal units. **Maximum run of flexible duct shall be 6 feet.**
- L. Take-offs from low pressure trunks to diffusers shall be a factory-manufactured spin-in type fitting with air-scoop and manual balancing damper. Install take-off per the manufacturer's recommendations.
- M. Provide flexible duct connectors at air handling units at all supply, return and outside air duct connections if not factory provided. Provide flexible duct connectors at inlet and discharge of inline fans. Flexible duct connectors shall conform to NFPA 90A.
- N. Duct construction shall be as follows:
  - Rooftop Units
    - all supply and return ducts from rooftop units with supply ducts located above ceilings shall be single wall low pressure sheet metal ducts wrapped with 2.33" fiberglass ductwrap insulation

#### 3.4 SEISMIC RESTRAINT OF DUCTWORK:

- A. Seismically restrain all ductwork with cable restraints as listed below:
  1. Restrain rectangular ducts with cross sectional areas of 6 square feet and larger.
  2. Restrain round ducts with diameters of 28" and larger.
  3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
- B. Seismic cable restraints shall consist of steel cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Seismic loads shall be based on a peak acceleration coefficient of 0.15.
- C. No restraints are required if the duct is suspended by hangers 12" or less in length, as measured from the top of the duct to the bottom of the support where the hanger is attached. Hangers must be positively attached to the duct within 2" of the top of the duct with a minimum of two #10 sheet metal screws.
- D. Transverse restraints shall occur at 30' intervals or at both ends if the duct run is less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
- E. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as longitudinal restraints for a duct section connected perpendicular to it if the restraints are installed within four feet of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
- F. Walls, including gypsum board non-bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide solid blocking around duct penetrations at stud wall construction.

**END OF SECTION 23 31 13**

## SECTION 23 81 43

### MECHANICAL; HVAC, PACKAGED HEAT PUMPS

#### PART 1 - GENERAL

- 1.1 The provisions of the GENERAL CONDITIONS OF THE CONTRACT, the SUPPLEMENTARY CONDITIONS, and Section 23 00 00 Mechanical General of the Specifications, apply to the work under this Section to the same extent as if fully included herein.
- 1.2 All equipment and materials for this project shall be purchased from and furnished to the contractor by the manufacturer's local representative for Mechanical Design, Inc. No submittals for equipment or materials will be received where the local representative has not originated the submittal data for this project. All non compliant submittals will be promptly rejected.
- 1.3 Provide packaged heat pump units as shown on plans. Cooling and heating capacities shall be as listed on schedule on drawings. The unit shall be properly assembled and tested at the factory. It shall be designed for use with Refrigerant R410A.
- 1.4 Cooling capacity ratings shall be based on ARI standards.
- 1.5 Packaged heat pumps shall be tested in accordance with UL 559 or UL 1995.
- 1.6 Packaged heat pumps shall be Trane, models listed on drawings. or equal by Carrier.

#### PART 2 - PRODUCT

- 2.1 Provide horizontal packaged, one piece, air-to-air electric heat pumps designed to function as a year round air conditioning system. Units shall be completely assembled and tested complete with refrigerant charge and ready to operate. The total unit shall listed by U.L. and carry a U.L. label.
- 2.2 All wiring internal to the unit shall be colored and numbered for identification.
- 2.3 All units shall be provided with condenser coil guards.
- 2.4 Electric resistance heaters shall be internally wired nickel chromium elements with controls necessary for complete operation. Safety controls shall include primary high temperature and over current protection. Heaters shall be U.L. listed and shall comply with N.E.C.
- 2.5 **Economizer (Units larger than 5 tons)**
  - A. The assembly includes fully modulating 0-100 percent motor and dampers, minimum position setting, preset linkage, wiring harness with plug, spring return actuator and fixed dry bulb control. The barometric relief shall provide a pressure operated damper that shall be gravity closing and shall prohibit entrance of outside air during the equipment "off" cycle. The unit shall be furnished with barometric relief.
  - B. Differential enthalpy control shall be provided for either factory or field installation.

#### 2.6 REFRIGERATION CIRCUIT

- A. Unit compressors shall be welded fully hermetic reciprocating with crankcase heaters and suitable vibration isolators. Compressors shall be of same manufacturer as unit and shall be tested and designed in unit to operate down to -20°F outdoor air temperature on the heating cycle without shutting off. The standard unit shall be capable of operating down to 35°F outdoor air temperature on the cooling cycle. Compressors shall have a five year non-prorated warranty. Where noted in schedule on drawings, provide low ambient kits to allow cooling operation to 0°F.
- B. Units shall provide space neutral air in dehumidification mode. Unit(s) shall consist of insulated weather tight casing with compressor(s), air cooled condenser coil, condenser fans, evaporator coil, hot gas reheat coil and refrigerant diverter valve, subcooling condenser circuit, return air filters, supply motors and unit controls.



1. Unit shall incorporate factory mounted modulating hot gas reheat coil capable of reheating cooled air to space neutral temperatures. Unit shall incorporate refrigerant diverting valve capable of diverting refrigerant to reheat circuit or condensing circuit as necessary.
  2. Unit shall divert refrigerant as necessary to hot gas reheat coil in the supply airstream when in dehumidification mode to reheat dehumidified supply air to space neutral temperature.
  3. Unit shall use refrigerant subcooling circuit in condensing section as necessary to maintain dehumidification capacity, supply air temperature, and unit efficiency.
- 2.7 Indoor and outdoor coils shall be aluminum plate fins mechanically bonded to seamless copper tubes.
- 2.8 Fans and Motors: Indoor air fan shall be forward curved, double width, double inlet, centrifugal type. Belt driven unit motor pulleys shall be adjustable pitch. Indoor fan motor shall have permanently lubricated bearings. Outdoor fans shall be propeller type with direct driven permanently lubricated motor. Fans shall discharge upward. Indoor and outdoor fans shall have internal thermal overload protection.
- 2.9 Unit cabinet shall be constructed of galvanized steel, phosphatized, and finished with an air-dry paint coating with hinged access panels. Structural members shall be 16 gauge with access doors and removable panels of minimum 20 gauge. Cabinet interior shall be insulated with ½" thick neoprene-coated fiberglass. Cabinet panels shall have hinged access for service to all operating components. A condensate drain for the indoor coil shall be provided.
- 2.10 Safety Controls: The heat pump heating/cooling system shall be protected with high pressurestat, low pressurestats, loss-of-charge protection, indoor coil freezestats, and current and temperature sensitive overload devices. Each of these devices shall be wired to prevent compressor restart. Two-compressor units shall have separate and independent refrigeration and control systems designed to allow for standby operation of either compressor if one is locked out. Two-compressor units shall have 2-stage compressor heat and cool with built-in electric strip heat lock out to prevent resistance heat operation above 40°F ambient.
- 2.11 An outdoor coil defrost system shall be incorporated into the base unit to prevent frost accumulation during heating cycle. The defrost cycle shall function on the basis of time and coil temperature. A 90-minute timer shall actuate a defrost mode only if coil temperature is low enough to indicate a heavy frost condition. Defrost shall have a positive termination time of a maximum of 10 minutes or when the defrost thermostat is satisfied to prevent prolonged operation on a defrost cycle. Electric resistance heaters shall operate automatically during the defrost cycle.
- 2.12 Thermostats shall be dual setpoint/automatic changeover with fan control. Thermostats shall be programmable with "occupied" heating and cooling temperature setpoints, and "unoccupied" heating and cooling temperature setpoints. Thermostats shall be furnished with equipment and bear the same name as the rooftop heat pump components.
- 2.13 Emergency heat control shall consist of emergency heat control box containing emergency heat relays and outdoor thermostats; and an emergency heat thermostat subbase (with warning light). Control shall allow for manual bypass of compressor and outdoor thermostats if compressor becomes inoperative, or for service. Outdoor thermostats shall provide for staging of electric resistance heat according to outdoor temperature. Thermostats shall be wired into the electric heater contactors and shall have an adjustable set point to provide economical resistance heat staging.
- 2.14 Time delay circuit to prevent compressor short cycling as a result of a rapid change in thermostat setting and automatically prevents compressor restart at least 5 minutes after shutdown.
- 2.15 Provide for each stage of electric heat on outdoor thermostat to lock out electric heat when outdoor temperature is below its setpoint. Provide emergency heat switch on thermostat to bring on heat if the compressor fails.
- 2.16 Fresh Air Intake Hoods:
1. Provide units larger than 5 tons with fresh air intake hood with modulating motor operated damper capable of 100% economizer operation. The unit shall have a differential enthalpy controller to initiate the economizer sequence otherwise controlled by a CO2 sensor and occupied/unoccupied schedule..
  2. Provide units 5 tons and smaller with fresh air intake hood with modulating motor operated damper capable of 25% outdoor air. The outdoor air damper shall be controlled by a CO2 sensor and occupied/unoccupied schedule.
- 2.17 The unit shall be controlled by a sensor furnished by the EMS contractor. Unit control wiring shall enable or disable the following instructions as a minimum:

1. Compressor operation and staging
  2. Evaporator fan control and fan only operation
  3. Limit the operation of electric heat during warm up period from unoccupied to occupied mode or temperature set point alteration .
  4. Economizer or fresh air operation
  5. Initiate a de-humidification sequence.
- 2.18 Unit shall provide space neutral air in dehumidification mode. Unit(s) shall consist of insulated weather tight casing with compressor(s), air cooled condenser coil, condenser fans, evaporator coil, modulating controllable hot gas reheat coil and refrigerant diverter valve, subcooling condenser circuit, return air filters, supply motors and unit controls .
1. Unit shall incorporate factory mounted hot gas reheat coil capable of reheating cooled air to space neutral temperatures. Unit shall incorporate refrigerant diverting valve capable of modulating refrigerant to reheat circuit or condensing circuit as necessary.
  2. Unit shall divert and modulate refrigerant as necessary to hot gas reheat coil in the supply airstream when in dehumidification mode to reheat dehumidified supply air to space neutral temperature.
  3. Unit shall use refrigerant subcooling circuit in condensing section as necessary to maintain dehumidification capacity, supply air temperature, and unit efficiency.

2.19 **CONDENSER COIL GUARDS**

Provide units with condenser coil hail guards. PERFORATED PANELS ARE NOT ACCEPTABLE.

**PART 3 - EXECUTION**

- 3.1 Mount units on curb installed by General Contractor. Install unit per manufacturer's written installation instructions. Curbs shall be attached to the roof deck, below the roof insulation, as required to comply with the seismic requirements of the 2015 International Building Code. Install unit per manufacturer's written installation instructions.
- 3.2 Provide hold downs between rooftop units and curb to comply with the seismic requirements of the 2015 International Building Code.
- 3.3 Provide construction filters. Change to 2" pleated MERV 13 throwaway type after substantial completion.
- 3.4 **CONDENSATE DRAIN PIPE**
- A. Provide 3" deep Type L copper P-trap at connection to condensate drain. Pipe full size condensate drain pipe from rooftop unit down to nearest roof drain.
  - B. Support pipes from existing roof on 8'-0" centers with closed-cell polyethylene pipe pier as manufactured by Michigan Hanger. Include pipe clamp to secure pipe to pipe pier. Provide 3 layers of roofing felt below pipe pier with hot mopped pitch.
- 3.5 Provide an aluminum prefabricated roof curb for each unit. Curb shall be sloped so top of unit is level. Verify slope of roof with Architectural drawings and specifications prior to ordering curb. Installation of roof curbs is not included under Division 23.
- 3.6 Set the open position of the outside air hood motorized damper at O.A. CFM listed in schedule on drawing.

END OF SECTION 23 81 43

## SECTION 25 55 00 - MECHANICAL

### HVAC, AUTOMATIC TEMPERATURE CONTROL

#### PART 1 - GENERAL

- 1.1 The provisions of the GENERAL CONDITIONS OF THE CONTRACT, the SUPPLEMENTARY CONDITIONS, and Section 23 00 00 Mechanical General of the Specifications, apply to the work under this Section to the same extent as if fully included herein.
- 1.2 This specification defines the minimum equipment and performance requirements for a building control system.
- 1.3 The automatic temperature controls shall be as specified herein and shall be complete in every respect. The system shall include all sensors, operators, and any other associated accessories required to fulfill the intent of these specifications.
- 1.4 Provide a complete system of electric temperature controls as described herein. The system shall be installed complete by competent mechanics regularly employed by the temperature controls contractor.
- 1.5 Furnish to architect/engineer four (4) copies of brochure containing control specifications data sheets on all control components relating to specific project. Incorporate in each brochure a complete control and interlock wiring diagram showing final connections to controls and controlled equipment. Procure from manufacturer wiring data of actual equipment to be used on project and incorporate this on control wiring diagram.
- 1.6 Control diagrams shall be furnished to the owner. The Temperature Controls and Building Management System Hardware will be furnished under this contract. All controls equipment shall be Siemens to match the existing Talon system onsite. Approved contractors to bid this project are:

Palmetto Controls, Inc.  
3101 Carlisle Street  
Columbia, SC., 29205  
(803) 765-9070

#### 1.7 SUBMITTALS

Submit complete control package including diagrams, control components, points lists and sequence of operation for Engineer's and Owner's review prior to beginning work. Obtain actual equipment manufacturer's wiring diagrams for coordination.

- 1.7 Control system power supply shall be served by a separate breaker and fused in control center for secondary protection.

#### 1.8 OWNER INSTRUCTION

- A. Upon completion of the control system, the entire control system shall be thoroughly checked and certified in letter form to the Engineer that all thermostats and controls have been checked and calibrated and are working properly, that the sequence of operation has been checked, all components have been labeled, record diagram has been prepared and the Owner's representative has been thoroughly instructed in and is familiar with all controls operations.
  - B. System shall be completely programmed with all control sequences, set points, schedules, etc. required for operations in any season. Provide continual service for one year to monitor, test, and verify that all systems perform as they should in all seasons and throughout one complete year from project closeout.
- 1.9 Motor starters shall be furnished under this section of the specifications. The contractor shall furnish starters, disconnects or combination starter/disconnects as shown on the electrical drawings. Refer to the electrical drawings for the type required for each piece of equipment. Mounting and wiring of starters including wiring to equipment shall be provided under electrical section of the specifications.

### 1.10 SCOPE OF WORK

Provide disconnect and reconnect of existing controls associated with the packaged rooftop heat pumps. Provide new Siemens devices as required for a complete system as described below.

## PART 2 - PRODUCTS

### 2.1 SUBMITTALS/DRAWING

The Control Contractor shall submit prior to installation a set of installation drawings and control strategies for review by the consultant and/or owner's representative. These drawings shall include the physical location of building control system equipment and system architecture. The complete sequence of operation of the control system shall be provided. Upon completion of the installation and final system adjustment, the Control Contractor shall provide a full set of as built drawings of the installation and the control strategies. In addition, the Control Contractor shall provide as built control drawings in AutoCAD format Framed control diagrams shall be mounted on the wall inside the appropriate mechanical room.

### 2.2 GUARANTEE:

The entire control system shall be installed by the control manufacturer and guaranteed free of defects and shall include required servicing and maintenance for a minimum of one year after final acceptance.

### 2.3 CONTROL AND INTERLOCK WIRING:

- A. All electrical work required under this section of specifications shall comply with the latest National Electrical Code. Control system power supply shall be served by a separate breaker and fused in control center for secondary protection.
- B. All control wiring shall be run in rigid conduit below grade or, on outdoor installation. All control wiring in walls or above the ceiling (or in equipment rooms where permitted by electrical specifications) shall be run in EMT. PLENUM CABLE WILL NOT BE ACCEPTED.
- C. Control wiring shall be color coded #16 TFF of TFFN wire with 600 volt insulation. Run all wiring between terminal points without changing color. Color code of control wiring shall be as indicated on control wiring diagram. Multi conductor thermostat cable will not be acceptable.

### 2.4 TRAINING/OWNER'S INSTRUCTION

The Control System Contractor shall provide two copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the system. The Control System Contractor shall instruct the Owner's designated representatives in these procedures during the start-up and test period. These instructions are to be conducted during normal working hours.

### 2.5 TELECOMMUNICATIONS CAPABILITIES

A telecommunications interface shall be furnished as necessary to allow direct connection of the Building Management and Control System to public and private phone lines. The telecommunications interface shall have automatic answer capabilities to allow it to be accessed from a remote control computer or terminal with modem. The interface unit shall be able to allow the person calling access to any information on the network, provided that the standard log-on security screening is met.

### 2.8 ELECTRONIC THERMOSTAT MODULES

- A. The ETM will be a complete stand alone controller and will operate on default values if communications is lost with the central processor. The control action will be PID (proportional-integral-derivative). The ETM will also contain the resident program and data acquisition for optimum start/stop, run time logs and timed override logs. Alarm will be reported to the central processor for temperature driftlimit problems.

- B. All setpoint and function adjustments will be made at the central processor. No adjustments will be possible at the ETM other than to initiate the timed override circuit.
- C. Status lights will provide confirmation of system communications, function and output status.
- D. Outputs will be as follows:
  - 1. Fan Speed 1
  - 2. Fan Speed 2 (2 stage units)
  - 3. Cool 1
  - 4. Cool 2 (2 stage units)
  - 5. Heat 1
  - 6. Heat 2 (2 stage units)
  - 7. Dehumidification
- E. Inputs will be as follows:
  - 1. Space temperature
  - 2. Timed override
  - 3. Air flow failure
  - 4. Space humidity

## 2.9 SMOKE DETECTORS

- A. Provide a self-contained duct mounted ionization smoke detector located in the return air duct downstream of the for all air handling units greater than 2000 CFM capacity and for all units serving a means of egress regardless of CFM capacity. (This is generally shown, but not limited to symbol SD) Supply air smoke detector shall be installed in accordance with NFPA 90A and NFPA 72E.
- B. Detector shall stop air handling unit, energize red alarm light and send alarm to the central fire alarm system. Ionization detector shall be compatible and fully integrated with the existing fire alarm system. **Coordinate with the existing fire alarm manufacturer requirements for integration to fire alarm system.** Alarm light and remote reset shall be visible from the floor without raising ceiling panels.
- C. Responsibility for the installation of the detector shall be provided under Division 23. This shall include mounting, control interlock wiring and coordination of power wiring with the electrical contractor. Connection to fire alarm system shall be provided by the electrical contractor and the provider of the existing fire alarm protection system.

## PART III - EXECUTION

### 3.1 SEQUENCE OF OPERATION

- A. Packaged Heat Pump Units
  - 1. A unit controller, room sensor and room humidity-sensor shall be provided for each unit. The controller shall enable the unit for operation according to its individual occupied/unoccupied schedule. The unit status by sensing line current at the starter shall be monitored and alarmed. The alarms shall be locked out for 30 seconds (adjustable) upon system start-up and de-energized during shut-down to avoid nuisance alarm. Failure to start and failure to stop alarms will be indicated at the operators terminal. The controller shall control the unit stages of heating, VFD (if applicable) and cooling sequence to maintain the space temperature set points. Supply air temperature shall be 55°F (adjustable); the maximum shall be 110°F (adjustable). Provide a PID program and time delays as required to prevent cycling of controls.
  - 2. For single zone VAV units, a room temperature sensor located in the space shall control the VFD and compressor staging based on deviation from set point to maintain space temperature. A discharge air temperature sensor shall control the unit to maintain temperature based on stages of heating and cooling. The discharge air temperature shall not be less than 55F (adj) cooling and not greater than 105F (adj) heating. When the space temperature is satisfied the fan speed shall operate at 25% airflow (adj).

3. When the relative humidity is above the set point 60% (adj) as sensed by the space humidity sensor, the unit will be overridden to full cooling. The economizer cycle is locked out and hot gas reheat modulates to maintain neutral air temperature. The unit returns to normal operation when the relative humidity falls below 60%. Cooling shall be priority call.
4. The motorized outside air damper shall remain closed during all unoccupied times. The motorized outside air damper shall remain closed upon the initial start up of the unit. After the room has reached its warm-up or cool-down temperature, the outside air damper shall open to its minimum position based on occupancy schedule.
5. The outdoor air damper and gravity relief damper shall be set to minimum outdoor air as scheduled on the drawings. Where noted on the drawings, two CO2 Sensors located in the return air duct shall be averaged to override the minimum O.A. and modulate the outdoor air damper from the zero to minimum position. **In no case shall the outdoor air damper modulate above the minimum CFM setpoint except on economizer operation.** Return and O.A. Dampers shall set accordingly to neutral building pressure based on building pressure sensor. The motorized outside air and relief damper shall remain closed under the following events:
  - a. all unoccupied times
  - b. Initial start up of the unit.
  - c. Morning warm-up

The motorized outside air and relief damper shall open under the following events:

- a. all occupied times
  - b. Initial start up of the unit. After the room has reached its warm-up or cool-down temperature, the outside air damper shall open to its minimum position and shall be modulated based on CO2 levels.
  - d. Economizer - A enthalpy based economizer set to operate whenever the outdoor air temperature is below 70 (adj) and shall override the CO2 control and modulate the fresh air, return and relief dampers whenever the heat content of the outside air is below the heat content of the return air. The RTU's mixed air sensor prevents mixed air temperature from falling below 55 degrees by modulating the outside air dampers.
6. A differential enthalpy based economizer shall control the fresh air and relief dampers whenever the heat content of the outside air is below the heat content of the return air unless overridden by the space humidistat. The unit's mixed air sensor prevents mixed air temperature from falling below 55 degrees by modulating the outside air dampers and/or energizing the heat coil.
  7. When commanded to change over to the Unoccupied Mode, the unit controller shall raise the cooling set point and lower the heating Set point to an operator determined value.
  8. During the Unoccupied Mode, the unit controller may be reset to the Occupied Mode for an operator determined time period. This reset shall be activated by a signal from a local override switch on the room temperature sensor or by command from the operator's terminal. At the end of the operator determined time period, the terminal equipment controller shall return to the Unoccupied Mode.

### 3.2 CERTIFICATION

Furnish to engineer two copies of certifications signed by authorized representative that:

1. Control system has been checked-out and operates according to drawings and specifications.
2. All controls are guaranteed unconditionally for two years from date of acceptance and will be serviced for this period free of charge.
3. Maintenance personnel or responsible party has been instructed as to the operation of control system.

**END OF SECTION 25 55 00**