SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install hangers and supports and required appurtenances for HVAC piping and equipment as required to complete the Work.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the hangers and supports Work.
   2. Notify other contractors in advance of the installation of the hangers and supports to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the hangers and supports Work.

C. Related Sections:
   1. Applicable Sections of Division 23, HVAC.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American National Standards Institute, (ANSI).
      a. ANSI B1.1, Unified Inch Screw Threads, (ASME B1.1).
   2. American Society for Testing and Materials, (ASTM).
      a. ASTM A 36/A 36M, Specification for Carbon Structural Steel.
      b. ASTM A 47/A 47 M, Specification for Ferritic Malleable Iron Castings.
      c. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
      d. ASTM A 575, Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
      e. ASTM A 668/A 688M, Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
   3. Federal Specifications, (FS).
      a. FS WW-H-171, Hangers and Supports, Pipe.
   4. Manufacturer Standardization Society, (MSS).
      a. MSS SP 58, Pipe Hangers and Supports-Materials, Design and Manufacture.
      b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.
   5. Underwriters' Laboratories, Incorporated, (UL).

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. American National Standards Institute, (ANSI).
   2. Institute of Electrical and Electronic Engineers, (IEEE).
   3. National Electrical Code, (NEC).
   4. National Electrical Manufacturers' Association, (NEMA).
   5. National Fire Protection Association, (NFPA).
   6. Underwriters Laboratories, Incorporated, (UL).
   7. Local and State Building Codes and Ordinances.
   8. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

C. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section, regardless of the component manufacturer, from a single hangers and supports manufacturer.
   2. Require the hangers and supports manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the hangers and supports manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
      b. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP 58 and MSS SP 69 and Federal Specification WW-H-171, latest edition.
   2. Shop Drawings
      a. Drawings showing fabrication methods, assembly, accessories, installation details.
      b. All hangers, inserts and supports for piping system specified.
      c. Location, installation, material, loads or forces, and deflection of all hangers and supports.
      d. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

e. Deviations from Contract Documents.

B. Informational Submittals: Submit the following:
   1. Source Quality Control Submittals:
      a. Submit factory test reports.
   2. Certificates:
      a. Submit independent certification reports.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.

B. Storage of Materials:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 WARRANTY

A. Completed equipment systems shall carry manufacturer's warranty

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. The manufacturer shall conform to the following criteria:
   1. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible.
   2. Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment concentration.
   3. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and

prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.

4. Hangers shall be designed so that they cannot become disengaged by movements of the supported pipe.

B. Components of hangers and supports shall conform to the following:
   1. Materials:
      a. Bolts: ASTM A 307, Grade A, unless otherwise specified below.
      b. Forgings: ASTM A 668/A 688M.
      c Malleable Iron: ASTM A 47/A 47 M.
      d. Rods and Bars: ASTM A 575.
      e. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1.
      f. Structural Steel: ASTM A 36/A 36M.
   2. Finish:
      a. Steel or malleable iron items, framing members, hangers, rods, bolts, nuts, inserts, washers and appurtenances located in corrosive areas shall be Type 316 stainless steel and those located in non-corrosive areas shall be galvanized steel. Refer to the corrosive and non-corrosive designation table on the Drawings for a list of these areas.
      b. Steel or malleable iron materials used for the support of uninsulated copper piping or plastic piping shall be PVC coated.

C. Pipe Attachments: The following types of pipe attachments shall be considered acceptable:
   1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.
   2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
   3. Steel Pipe Clamp: FS WW-H-171E, Type 4.
   4. Adjustable Swivel Pipe Ring: FS WW-H-171E, Type 6.
   5. Adjustable Steel Band Hanger: FS WW-H-171E, Type 7.
   6. Riser Clamp: FS WW-H-171E, Type 8.
   7. Light-Duty Clevis Hanger: FS WW-H-171E, Type 12.
   8. Long Clips: FS WW-H-171E, Type 26.
   9. Offset J-Hooks: FS WW-H-171E, Type 27.
   10. Steel Pipe Covering Protection Saddle: FS WW-H-171E, Type 40A.
   11. Insulation Protection Shield: FS WW-H-171E, Type 41.
   12. Pipe Saddle Support: FS WW-H-171E, Type 37.
   13. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
   14. Pipe Saddle Support with Base: FS WW-H-171E, Type 36.
   15. Adjustable Roller Hanger: FS WW-H-171E, Type 42.

D. Structural Attachments: The following types of structural attachments shall be considered acceptable:
   1. Side Beam Clamp: FS WW-H-171E, Type 20.
   2. Center I-Beam Clamp: FS WW-H-171E, Type 21.
   3. Welded Steel Bracket: FS WW-H-171E, Types 32 and 33.
   4. Side Beam Bracket: FS WW-H-171E, Type 35.
   5. Malleable Iron with Galvanized Finish Concrete Insert: FS WW-H-171E, Type 18. Steel inserts are NOT acceptable.

E. Hanger Rod Attachments: Use as required to complete assembly:
   1. Forged Steel Clevis: FS WW-H-171E, Type 14.
   2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
   3. Forged Steel Welders Eye Nut: FS WW-H-171E, Type 17.\

2.2 SOURCE QUALITY CONTROL

A. Source Quality Control:
   1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards.
   2. Tested and inspected for approval as a unit by Underwriters' Laboratories, Inc., UL Label.
   3. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the package meets the specified performance requirements including manufacturer's data report.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
   1. Install all items as shown, specified, and as recommended by the manufacturer.
   2. Request instructions from Engineer, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
   3. Present conflicts between equipment and structures to Engineer who shall determine corrective measures to be taken.
   4. Do not modify structures to facilitate installation of equipment, unless specifically approved by Engineer.
   5. Installation to conform to requirements of all local and state codes.
   6. Insulated pipes with vapor barriers shall have an insulation protection shield conforming to FS WW-H-171E, Type 41 tack-welded to hanger.
   7. Insulated pipes without vapor barriers shall have a steel protection saddle conforming to FS WW-H-171E, Type 40A.
   8. All uninsulated copper piping shall be supported by plastic coated steel pipe attachments.
   9. All piping shall be braced as required, to prevent sway in any direction.
   10. All insulated piping 3-inch diameter and larger shall be supported by roller hangers conforming to FS WW-H-171E, Type 42.

B. Supports and Hangers for Horizontal Pipes:
   1. Space supports and hangers for all piping no farther apart than shown below, unless otherwise shown:
      a. Copper Tube:
         1) All Pipes: 6 feet-0 inch center.
      b. Steel Pipe:

1) Pipes up to 1-inch: 6 feet-0 inch center.
2) Pipes 1-1/4-inch to 6-inch: 8 feet-0 inch center.

2. Additional supports shall be placed immediately adjacent to any change in piping direction, and on both sides of valves and couplings.

C. Hanger Rods: Size hanger rods according to the schedule below, unless noted otherwise:

Nominal Pipe (Inches)	Rod Diameter (Inches)
1/2 through 2	3/8
2-1/2 through 3-1/2	1/2
4 through 5	5/8
6	3/4

D. Supports for Vertical Piping:
1. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve at each floor level.
2. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
3. Support spacing shall not exceed code requirements.
4. Piping support intervals shall not exceed those listed in Paragraph 3.2.B., above.
5. Additional supports shall be placed immediately adjacent to any change in piping direction, and on both sides of valves and couplings.

E. Allow clearances for expansion and contraction of piping.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Test all equipment in operation.
2. Check for excessive vibration while all systems are operating.
3. Installed systems and components shall not be released to Owner unless all systems have been tested and approved by the Engineer.

B. Inspection:
1. Examine areas to receive equipment and accessories for:
a. Defects that adversely affect execution and quality of the Work.
b. Deviations beyond allowable tolerances.
c. Start the Work only when conditions are satisfactory.
2. The Engineer reserves the right to reject and/or authorize replacement of equipment and accessories found to be defective, blistered, cracked and/or deviated from allowable tolerances.

3.3 ADJUSTING AND CLEANING

A. Adjusting:

1. Adjust all equipment.

B. Cleaning:
   1. Thoroughly clean all equipment and accessories prior to installation.
   2. Remove all dirt, rust, dust, etc. from equipment.
   3. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to perform the testing, adjusting and balancing for HVAC as specified herein.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the testing, adjusting and balancing for HVAC Work.
   2. Notify other contractors in advance of the installation of the testing, adjusting and balancing for HVAC to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the testing, adjusting and balancing for HVAC Work.

C. Related Sections:
   1. Section 09 91 00, Painting.

1.2 QUALITY ASSURANCE

A. Balancer's Qualifications:
   1. Balancer shall have a minimum of five years of experience of testing, adjusting and balancing substantially similar equipment, and shall be able to show evidence of at least five adjustments in satisfactory operation for at least five years.
   2. Submit biographical information on employee proposed to directly supervise the testing, adjusting and balancing for HVAC Work.
   3. Submit proof of certification by National Environmental Balancing Bureau (NEBB) and/or Association Air Balance Council (AABC).

B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. Associated Air Balance Council, (AABC).
   2. Air Moving and Conditioning Association, (AMCA).
   3. American National Standards Institute, (ANSI).
   4. American Refrigeration Institute, (ARI).
   5. Institute of Electrical and Electronic Engineers, (IEEE).
   6. National Electrical Code, (NEC).
   7. National Electrical Manufacturers' Association, (NEMA).
   8. National Environmental Balancing Bureau, (NEBB).

9. National Fire Protection Association, (NFPA).
10. Sheet Metal and Air Conditioning Contractors' National Association, (SMACNA).
11. Underwriters' Laboratories, Incorporated, (UL).
12. Local and State Building Codes and Ordinances.
13. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit samples of data sheets on each item of equipment.
      b. Submit data sheets on each item of testing equipment required.
      c. Include name of devices, manufacturer's name, model number, latest date of calibration and correction factors.
      d. Valve Charts:
         1) Frame and Glazing: 1/8-inch sheet acrylic in 8-1/2 by 11-inch extruded aluminum frame.
         2) Charts: Typed with the following information on each valve:
            a) Valve identification number.
            b) Valve location.
            c) Valve use.
            d) Vale size.
            e) Manufacturer's name and model.
         3) Valve Tags: Submit sample of valve tag with sample identification lettering.

B. Informational Submittals: Submit the following:
   1. Site Quality Control Submittals:
      a. Submit specimen copies of report forms for Engineer's review.
      b. Forms shall be 8-1/2 by 11-inch paper for loose-leaf binding, with blanks for listing all required testing ratings and certification of report.
      c. Reports shall be on the organizations approved forms imprinted with the company's name.
      d. Certified report, outlining procedure used to balance the system and the types of measuring devices used.
      e. Submit test results on approved forms in typed format.
      f. Submit a minimum of three certified copies of required test reports to the Engineer for review.
   2. Qualifications Statements:
      a. Submit balancer's qualifications

C. Closeout Submittals: Submit the following
   1. Operations and Maintenance Manuals:
      a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.

b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.4 OPERATING INSTRUCTIONS

A. Written startup and field test reports must be submitted to Engineer and Owner for approval prior to Owner's acceptance for responsibility.

1.5 CORRECTIVE ADJUSTMENTS

A. Should corrective measures caused by faulty installation require re-testing, adjusting and balancing, such Work shall be at no additional cost to the Owner.

B. Inspections:
   1. Inspect all equipment for proper operation prior to testing, adjusting and balancing.

PART 2 – PRODUCTS

2.1 GENERAL

A. Contractor shall provide all necessary instrumentation, tools, ladders, etc. to complete all air and hydronic balancing tests and adjustments.

B. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards demanded by these organizations.

C. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.

D. Contractor shall assume full responsibility for safe keeping of all instrumentation during the course of the Work.

2.4 SYSTEM PERFORMANCE MEASURING INSTRUMENTS

A. Provide insertion thermometers, sling psychrometers, tachometers, revolution counters, clamp-on volt-ammeter recorders, and other instruments as required to measure all facets of the complete HVAC system performance.

PART 3 – EXECUTION

3.1 GENERAL

A. All testing, adjusting, and balancing of air systems shall be performed in compliance with the standard procedure manual published by the testing, adjusting,

and balancing organization affiliated with Contractor. Contractor shall submit one copy of the standard procedure manual to the Engineer for their records.

B. Contractor shall be solely responsible for the protection and safeguarding of the Work and shall provide every protection against accidents, injury, and damage to persons and property.

C. Contractor shall keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day's Work.

D. Contractor shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.

E. Contractor shall install additional access panels at no extra cost to the Owner, as is required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.

F. Air systems shall be tested, adjusted, and balanced with clean filters.

3.2 JOB CONDITIONS

A. Heating, ventilating and air conditioning equipment shall be completely installed and in continuous operation, as required, to accomplish the testing, adjusting and balancing Work specified.

B. Testing, adjusting and balancing shall be performed when outside ambient conditions are approximate to the design conditions for all heating and cooling functions.

D. Test, adjust and balance all air systems, ductwork, etc. and their control systems.

3.3 INSPECTION

A. Pre-Startup Inspection:
   1. Verify proper equipment mounting and setting.
   2. Verify that control, interlock and power wiring is complete.
   3. Verify alignment of motors and drives.
   4. Verify proper piping connections and accessories.
   5. Verify that lubrication is completed.

B. First Run Observations:
   1. Verify direction of rotation.
   2. Verify setting of safety controls.
   3. Monitor heat build-up in bearings.
   4. Check motor loads against nameplate data.

C. Equipment Check:

1. Verify proper overload heater sizes.
2. Verify function of safety and operating controls.
3. Verify proper operation of equipment.
4. Report on inspection, observation and checking procedures.

3.4 AIR SYSTEMS

A Test, adjust and balance systems in accord with the AABC "National Standards for Field Measurements, Total System Balance, Air Distribution, Hydronics Systems", Volume One, Number 81266, or SMACNA's "Air Handling" Specification.

B. Preliminary:
1. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.

C. Central Systems:
1. Test rpm for all equipment, including adjusting of each fan, air handling unit, and air conditioning unit to design requirements within the limits of mechanical equipment provided.
2. Test and record motor voltages and running amperes including motor nameplate data, and starter heater ratings for each unit as listed above.
3. Make pitot tube traverse of main supply, exhaust and return ducts, determine cfm at all fans and units and adjust fans and units to within five percent of design requirements.
4. Test and record system static pressure, suction and discharge.
5. Test and adjust system for design outside air, (cfm).
6. Test and adjust system for design recirculated air, (cfm).
7. Test and record heating apparatus entering air temperatures, (dry bulb).
8. Test and record cooling apparatus entering air temperatures, (dry bulb and wet bulb).
9. Test and record heating apparatus leaving air temperatures, (dry bulb).
10. Test and record cooling apparatus leaving air temperatures, (dry bulb and wet bulb).
11. Record all fan and air handling unit speeds.
12. Record air quantity delivered by each fan and air-handling unit.

D. Distribution:
1. Adjust volume dampers, control dampers, splitter dampers, etc., to proper design CFM in main ducts, branch ducts, and zones.

E. Air Terminals:
1. Identify each air terminal as to location and determine required flow reading.
2. Test and adjust each air terminal to within tolerance of design requirements as listed below.
    a. Diffusers and Supply Registers: 0 percent to +10 percent.
    b. Return Registers: 0 percent to -10 percent.
    c. Exhaust Registers: 0 percent to -10 percent.

3. Test procedure on air terminals shall include recording comparison of required cfm and observed cfm, adjustment of terminal, and recording of final cfm.
4. Adjust flow patterns from air terminal units to minimize drafts to the extent that the design and equipment permits.

F. Verification:
1. Prepare summation of readings of observed cfm for each system, compare with required cfm, and verify that duct losses are within specified allowable range.
2. Verify design cfm at fans as described above.
3. If the air systems are not properly balanced, Contractor shall rebalance and recheck all data in the presence of the Engineer and as accepted by the Engineer.

3.6 AUTOMATIC CONTROL SYSTEM

A. In cooperation with the control manufacturer's representative, set and adjust automatically operated devices to achieve required sequence of operations.

B. Testing organization shall verify all controls for proper calibration and list those controls requiring adjustment by control system installer.

3.7 MAINTENANCE AND REPAIR

A. Maintenance and Repair:
1. Provide all labor, tools and equipment to provide a Preventive Maintenance Program and make repairs for all equipment and controls during the one-year correction period after the Final Acceptance by Owner. Contractor shall provide the following services for the same period of one year:
a. Receive calls for all problems and take steps to immediately correct deficiencies, which may exist.
b. Provide a monthly inspection of all equipment, and record the findings on a checklist hereinafter specified.
c. Provide a Preventive Maintenance Schedule for the principle items of equipment.
d. Respond to Owner and make repairs for all equipment and controls within 24-hours of notification by Owner.

B. Check List:
1. Provide a checklist and post a copy of it, where directed by the Owner.
2. Include each piece of equipment specified or shown.
3. Provide four columns for required quarterly inspections.
4. Provide columns for the following:
a. Equipment condition.
b. Equipment operation.
c. Equipment lubrication.
d. Preventive maintenance.

5. Preventive maintenance shall be performed in accordance with the manufacturer’s recommendations and accepted practice.

3.8 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of one visits, minimum 4 hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visit shall be for checking the completed installation, start-up of the system. Manufacturer's representative shall test operate the system in the presence of the Engineer and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

+ + END OF SECTION + +

SECTION 23 51 33

INSULATED SECTIONAL CHIMNEYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install insulated sectional chimney systems complete with accessories.

B. Coordination:

   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the insulated sectional chimneys Work.
   2. Notify other contractors in advance of the installation of the insulated sectional chimneys to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the insulated sectional chimneys Work.

C. Related Sections:
   1. Division 23, Heating, Ventilating and Air Conditioning.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society of Heating, Refrigerating and Air Conditioning Engineers, (ASHRAE).
   2. Institute of Electrical and Electronic Engineers, (IEEE).
   3. National Electrical Code, (NEC).
   4. National Electrical Manufacturers' Association, (NEMA).
   5. National Fire Protection Association, (NFPA).
      a. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
      b. NFPA 211, Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances.
   6. Sheet Metal and Air Conditioning Contractors National Association, (SMACNA).
   7. Underwriters’ Laboratories, Incorporated, (UL).
      a. UL 103, Factory-Built Chimneys for Residential Type and Building Heating Appliances.

1.3 QUALITY ASSURANCE

A. Installer’s Qualifications:

1. Engage a single installer regularly engaged in insulated sectional chimney systems installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to Engineer.
2. Engage a single installer for the entire insulated sectional chimney system with undivided responsibility for performance and other requirements.

B. Component Supply and Compatibility:
1. Obtain all equipment included in this Section, regardless of the component manufacturer, from a single insulated sectional chimney manufacturer.
2. The insulated sectional chimney equipment manufacturer to review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the insulated sectional chimney equipment manufacturer.

C. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. American National Standards Institute, (ANSI).
2. Institute of Electrical and Electronic Engineers, (IEEE).
3. National Electrical Code, (NEC).
4. National Electrical Manufacturers' Association, (NEMA).
5. National Fire Protection Association, (NFPA).
6. Underwriters' Laboratories, Incorporated, (UL).
7. Local and State Building Codes and Ordinances.
8. Listing Agency: A nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation, that maintains periodic inspection of production of equipment and materials and publishers list stating either that the equipment or material listed meets nationally recognized standards or has been tested and found suitable for use in a specified manner.
9. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. 1/4-inch scale layouts, dimensioned to show length of runs, sizes, support spacing and expansion provisions.
b. Details of chimney connection to boilers and chimney supports from boilers.
c. Details of installation.
d. Supports.
e. Roof penetration and termination.
2. Product Data:

a. Manufacturer's literature, illustrations, specifications and engineering data for all equipment.
b. Total chimney weight supported from boiler top.
c. Other technical data related to the specified material and equipment as requested by Engineer.
d. Contractor shall provide certification that all stainless steel, accessories and hardware are of the specified type.

B. Informational Submittals: Submit the following:
1. Qualifications Statements:
a. Installer’s qualifications.

C. Closeout Submittals: Submit the following:
1. Record Documentation:
a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of the Work, submit CADD drawings showing the actual-in-place installation of all chimney systems installed under this Section, at a scale satisfactory to the Owner. The drawings shall show all chimney systems on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.

B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer’s recommendations for long-term storage.

C. Acceptance at Site:
1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.

B. The Drawings show an indication of the arrangement of equipment and chimney system and is as correct as can be determined in advance of the actual construction of the Work. Equipment, chimney systems, and appurtenances found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged as to fully and best suit the requirements of each particular case, adequately provide for expansion and minimize the amount of space required for the same.

D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, Contractor, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the Engineer.

E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. Contractor shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work “by others”, to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Chimney venting system shall comply with the following minimum conditions:
   1. Chimney: Suitable for continuous temperatures up to 1,400°F or 1,800°F for brief periods.

2.2 MANUFACTURERS

A. Products and Manufacturers: Provide one of the following:
   1. Schebler Corporation, Model P1.
   2. Metalbestos Products, Division of Wallace-Murray Corporation.
   3. Or equal.

2.3 DETAILS OF CONSTRUCTION

A. Type:
   1. Double-walled.
   2. Prefabricated.
   3. One-inch insulation between inner and outer wall.

B. Materials and Thickness:
   1. Chimney:
      a. Inner Wall:
         1) Stainless Steel: Type 316.
         2) 6-inch through 36-inch Diameter: 0.036-inch.
         3) 38-inch through 48-inch: 0.048-inch.
      b. Outer Wall:
         1) Stainless Steel: Type 304, except where located outdoors, which shall be Type 316.
         2) 6-inch through 36-inch Diameter: 0.030-inch.
         3) 38-inch through 48-inch: 0.048-inch.
   2. Insulation:
      a. One-inch.
      b. Rated for 1,600°F.
      c. Low conductivity ceramic fiber.
      d. Securely attached to the inner shell with steel straps and insulating pins welded to the inner shell.

C. Construction:
   1. All inner and outer shell seams shall be full penetration welded the entire length of the pipe section.
   2. Riveted, tack or spot welded seams are not permitted.
   3. Stainless steel centering clips shall be welded to the outer shell to maintain 1-inch spacing and ensure concentricity of the shells.

D. Accessories:
   1. Provide all fittings, components and structural supports required for a complete and operational chimney system, including but not limited to the following.
      a. Rain cap.
      b. Rain collar.
      c. Roof flashing.
      d. Roof support plate.
      e. Elbows.
      f. 45 degree lateral tees.
      g. Reducers.
      h. Wall guides.
      i. Wall supports.
      j. Adjustable sections.
      k. Support plates.
      l. Drain tee cap at base with 1-inch ball valve. Pipe drain to nearest floor drain.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install all items as shown, specified, and as recommended by the manufacturer.
   2. Request instructions from Engineer, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
   3. Present conflicts between chimney systems or equipment or structures to Engineer, in writing, who shall determine corrective measures to be taken.
   4. Do not modify structures to facilitate installation of chimney system, unless specifically approved by Engineer.
   5. Installation to conform to requirements of all local and state codes.
   6. Protection: Properly plug or cap the open ends of all chimney systems at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

B. All chimney systems shall conform accurately to the dimensions shown, the ducts shall be straight and smooth inside with joints neatly finished. Chimney systems shall be installed so as to preclude the possibility of vibration under all operating conditions.

C. Seal all joints in accordance with the manufacturer's standards.

D. Install all chimney systems and accessories to provide a system free from buckling, warping, breathing or vibration.

E. Provisions shall be made for supporting all chimney systems.

3.2 FIELD QUALITY CONTROL

A. Inspection:
   1. Examine areas to receive chimney systems and accessories for:
      a. Defects that adversely affect execution and quality of the Work.
      b. Deviations beyond allowable tolerances.
      c. Start the Work only when conditions are satisfactory.
   2. The Engineer reserves the right to reject or authorize replacement of chimney systems and accessories found to be defective or deviated from allowable tolerances.

3.3 ADJUSTING AND CLEANING

A. Adjusting:
   1. Adjust all controls for proper settings.

2. While system is operable, balance all equipment to achieve design conditions.

B. Cleaning:
   1. Thoroughly clean chimney systems and accessories prior to installation.
   2. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

SECTION 23 82 39.63

GAS-FIRED UNIT HEATERS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install gas-fired unit heaters complete and operational with accessories, including mounting hardware and room thermostats for proper operation.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the gas-fired unit heater Work.
   2. Notify other contractors in advance of the installation of the gas-fired unit heater to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, gas-fired unit heater Work.

C. Related Sections:
   1. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. Air Moving and Conditioning Association, (AMCA).
      a. AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
   2. American Society of Heating, Refrigeration, Air Conditioning Association, (ASHRAE).

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single gas-fired unit heater manufacturer.

2. The gas-fired unit heater equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the gas-fired unit heater equipment manufacturer.

C. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. American National Standards Institute, (ANSI).
2. Institute of Electrical and Electronic Engineers, (IEEE).
3. National Electrical Code, (NEC).
4. National Electrical Manufacturers' Association, (NEMA).
5. National Fire Protection Association, (NFPA).
6. Underwriters' Laboratories, Incorporated, (UL).
7. Local and State Building Codes and Ordinances.
8. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams.
b. Complete equipment list.
c. Detailed drawings of each individual component's wiring diagrams.
d. Detailed installation drawing of each individual component showing:
1) Mounting requirements.
2) Locations (panel, field, etc).
3) Piping and wiring connections, labeled and coded.
4) Instructions.
5) Materials of construction.
6) Data sheets.
2. Product Data:
a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
b. Other technical data related to specified material and equipment as requested by Engineer.
c. Detailed description of each component.
d. Catalog cut sheets.
e. Documentation from the manufacturer showing that paint systems will comply with Section 09 91 00. Include cut sheets for proposed paint systems.
3. Testing Plans, Procedures, and Testing Limitations:
a. Fan to be tested in accordance with AMCA 210.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit independent certification reports
   2. Supplier Instructions:
      a. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
   3. Source Quality Control Submittals:
      a. Submit factory test reports.

C. Closeout Submittals: Submit the following
   1. Operations and Maintenance Manuals:
      a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
      b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:
   1. Spare Parts:
      a. Spare parts list and recommended quantities.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design conditions shall be as indicated on the Equipment Schedules.

2.2 MANUFACTURERS

A. Manufacturers: Provide products of one of the following:
   1. The Trane Company.
   2. Modine Manufacturing Company.
   3. Sterling Gas Fired Heating Company.
   4. Or equal.

2.3 DETAILS OF CONSTRUCTION

A. Gas-Fired Unit Heaters:
   1. Casing:
      a. Heavy-gauge steel.
      b. Metal surface factory treated to prevent rust with baked enamel finish.
      c. Built-in adjustable discharge louvers.
   2. Burner:
      a. Gas-fired.
      b. Material: Aluminized steel.
      c. Design: Non-clogging, slotted ports.
      d. Port protector.
      e. Burner assembly shall be of unitized construction.
   3. Heat Exchanger:
      a. Construction:
         1) Design: Air-foil contoured tubes.
         2) Material: see schedule.
         3) Heliarc machine welded.
      b. Welded construction.
      c. Indirect fired.
   4. Fan:
      a. Propeller Type: Statically and dynamically balanced.
      b. Blower Type: Statically and dynamically balanced.
   5. Motor:
      a. Single speed.
      b. Single phase.
      c. Built-in overload protection.
      d. Factory-mounted and wired.
      e. Mounted with vibration isolators.
      f. Totally enclosed fan cooled.
   6. Efficiency: 80 percent, minimum.
   7. Accessories:
      a. Factory-wired and mounted.
      b. High limit switch.
      c. Ignition transformer and spark ignition controller.
      d. Unit mounted disconnect switch.
      e. Safety shutdown, 24 volt gas valve with 100 percent safety pilot shut off.

f. Manual shut off valve on gas line.
g. Fan controls.
h. Pressure regulator.
i. Leak limiting device.
j. Approved belt guard.

8. Draft diverter shall be integral part of heat exchanger.
   a. Construction: see schedule.

2.4 CONTROL ACCESSORIES

A. Space Thermostat:
1. Application: Heating.
2. Sealed Noryl case.
3. Shielded nickel-plated sensing bulb attached directly to thermostat enclosure.
4. Thermostat Setpoint Range: 40°F to 100°F.
5. Adjustable setpoints through dial on face.
6. 120 VAC.
7. Contacts shall have proper ampere rating for intended use.
8. Rating: NEMA 4X.
9. Products and Manufacturers: Provide one of the following:
   a. Chromalox, Model WCRT-100.
   b. Or equal.

B. Explosion-Proof Space Thermostat:
1. UL Listed for Class I, Group D hazardous locations. Explosion-proof construction.
2. Complete with built-in thermometer.
3. 40°F to 100°F Range with 1°F differential.
4. Tamperproof set point locking device.
5. Rating: 120 VAC, 125 VA rating.
6. Products and Manufacturers: Provide one of the following:
   a. Indeeco, Model C251-011.
   b. Or equal.

2.5 SUPPORTS

A. Contractor shall provide and install all additional hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances as required to mount equipment as shown. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall be galvanized steel.

2.6 PAINTING

A. All piping, equipment and accessories shall be painted in accordance with the requirements of Section 09 91 00, Painting.

B. Do not paint heat exchanger in non-corrosive areas.

C. All exterior and interior metal surfaces of unit heaters including coils located in corrosive areas shall be factory coated with a four-coat baked phenolic coating system minimum two to three-mils dry film thickness total, of Heresite Series P-413, or equal.

2.7 SOURCE QUALITY CONTROL

A. Source Quality Control: Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
   1. Tested and inspected for approval as a unit by Underwriter's Laboratories, Inc., UL Label.
   2. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the equipment meets the specified performance requirements, including manufacturer's data report.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:
   1. Install all items as shown, specified, and as recommended by the manufacturer.
   2. Request instructions from Engineer, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
   3. Present conflicts between equipment and structures to Engineer, in writing, who will determine corrective measures to be taken.
   4. Do not modify structures to facilitate installation of equipment, unless specifically approved by Engineer.
   5. Installation to conform to the requirements of all local and state codes.
   6. Install units and cabinets level and plumb.
   7. Install units in accordance with details on the approved Shop Drawings.
   8. Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical damage.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Fill all systems and fully test all equipment, valves, dampers, etc. in operation.
   2. Check for excessive vibration while all systems are operating.
   3. Installed systems and components will not be released to Owner unless all systems have been tested and approved by the Engineer.

B. Inspection:
   1. Examine areas to receive equipment and accessories for:
      a. Defects that adversely affect execution and quality of the Work.

b. Deviations beyond allowable tolerances for equipment and accessories.
c. Start the Work only when conditions are satisfactory.

2. The Engineer reserves the right to reject or authorize replacement of equipment and accessories found to defective, blistered, cracked or deviated from allowable tolerances as described above.

3.3 ADJUSTING AND CLEANING

A. Adjusting:
1. Adjust all controls for proper settings.
2. While system is operable, balance all equipment, valves, dampers, etc. to achieve design conditions.
3. Set air deflectors for proper air delivery.
4. Check room thermostat and wiring connections to unit heater.

B. Cleaning:
1. Thoroughly clean all piping, fittings, valves, equipment and accessories prior to installation.
2. Remove all dirt, rust, dust, etc. from piping, equipment and accessories in preparation for painting.
3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of (--1--) visits, minimum (--2--) hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up and training of the system. Manufacturer's representative shall test operate the system in the presence of the Engineer and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

+ + END OF SECTION + +