PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

A. The general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 General Requirements, apply to work in this Specification.

1.02 SUMMARY

A. Work Included: Complete, tested and operational HVAC systems - which include, but is not limited to the following:

1. Selective demolition of existing ductwork, piping & equipment.
2. Field fabricated metal equipment supports.
3. Equipment installation requirements.
4. Floor and wall penetration systems.
5. Hangers and supports.
6. Vibration control.
7. Mechanical identification.
8. Mechanical insulation.
9. Ductwork.
10. Duct accessories.
11. Variable air volume boxes.
12. Diffusers, registers and grilles.
13. Automatic Temperature Controls.
14. Testing, adjusting, and balance to include the following:
    - Balance airflow within distribution systems, including sub-mains, branches and terminals to indicated quantities according to specified tolerances.
    - Adjust total HVAC systems to provide indicated quantities, including replacement of sheaves and pulley to achieve desired flow rate.
    - Test, adjust and balance the following mechanical systems:
      a. Air systems.
      b. Hydronic systems.

B. Contractor shall conduct a thorough site visit before bid for HVAC is submitted. The bid shall include all g changes required to provide a complete system as indicated on the contract documents. Contractor shall provide all offsets, elbows, transitions, etc., required to avoid building structure, electrical, plumbing and fire protection systems.

1.03 SUBMITTALS

A. Submit product data for the following products.

1. Shop drawings detailing fabrication and installation for metal supports for mechanical materials and equipment.
2. Hangers and Supports. Include a licensed engineer's hanger and support drawings and installation report specified in other sections of this specification.
3. Vibration and seismic restraints.
4. Identification material and devices.
5. Mechanical insulation.
6. Ductwork, duct liner and sealing materials. Include duct fabrication drawings detailing:
   - Duct layout, indicating pressure class and sizes.
   - Fittings.
   - Reinforcement and spacing.
   - Seam and joint construction.
   - Penetrations through partitions.
   - Terminal unit installation.
   - Hangers and supports.
7. Backdraft dampers, manual volume control dampers, turning vanes and flexible ducts.
8. Variable air volume boxes. Including performance data for each size and type furnished.
9. Diffusers, registers and grilles. Including performance data for each type.
10. Rooftop units.
11. Hydronic equipment: CUH, UH, etc.
12. Automatic Temperature Controls.

B. Operating and Maintenance, (O&M) Manuals, (consisting of a bound, tabbed and indexed binder), for the following items.

1. Vibration control and seismic restraint.
2. Variable air volume boxes.
3. Diffusers, registers and grilles.
4. Rooftop units.
5. Hydronic equipment: CUH, UH, etc.

C. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the work. Include the following:

1. Planned duct systems layout, including elbow radius and duct accessories.
2. Clearances for installing and maintaining insulation.
3. Clearances for servicing and maintaining equipment.
4. Equipment service and connections and support details.

1.04 QUALITY ASSURANCE

A. All installations shall be in compliance with the following.

1. IBC - International building code.
2. NFPA-70 - National electrical code.
3. NFPA 90A: Standard for the installation of Air Conditioning and Ventilating Systems.
4. NFPA 90B: Standard for the installation of Warm Air Heating and Air Conditioning Systems.

B. Fire performance characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction.

C. Prepare hanger and support design drawings, and calculations for seismic restraint of equipment. Include seal and signature of a Registered Engineer, licensed in jurisdiction where project is located.

D. Testing, adjusting and balancing agent qualifications: Engage a testing, adjusting and balancing agent certified by either AABC or NEBB.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Hangers and Supports:

1. Grinnell Corp.
2. B-Line Systems, Inc.

B. Hanger Spring and Neoprene (HSN) Isolators:

1. Amber Booth Company, Type BSRA
2. Mason Industries, Inc., Type 30N
3. Kinetics Noise Control, Inc., Type SRH or SFH
4. Vibrations Mountings and Controls, Inc., Type RSH or RFH

C. Identifying Devices and Labels:

1. Brady: Signmark Div.; W.H. Brady Co.
2. Seton Name Plate Co.

D. Glass Fiber Insulation:

1. Certain Teed Corp.
2. Knauf Fiberglass.
3. Owens-Corning Fiberglass Corp.
4. Schuller.
5. USG Interiors, Inc. - Thermfiber Division.

F. Transverse Duct Connectors:

1. Ductmate
1. TDC

G. Duct Liner:

1. Knauf Fiber Glass
2. Owens Corning
3. Schuller International, Inc.

H. Duct Sealant:

1. Hardcast
2. United McGill

I. Volume Dampers:

1. Buckley Air Products, Inc.
2. Ruskin Mfg. Co.
3. United McGill Corp.

J. Turning Vanes:

1. Ductmate Industries, Inc.
2. Schuller International, Inc.
3. Tuttle&Bailey

K. Flexible Duct:

1. Flexmaster, Buckley Associates, Inc.
2. Thermaflex.

L. Diffusers, Registers and Grilles:

1. Titus
2. Kruegur
3. Anemostat

M. Fire Dampers:

1. Air Balance, Inc.
2. Prefco Products, Inc.
3. Ruskin Mfg. Co.

2.02 HANGERS AND SUPPORTS

A. Hangers, Supports and Components: Factory fabricated according to MSS SP-58.

1. Components include galvanized coatings where installed for equipment that will not have field applied finish.

B. Powder Actuated Drive-Pin Fasteners: Powder actuated type drive-pin attachments with pull out and shear capacities appropriate for supported loads and building materials where used.

C. Mechanical Anchor Fasteners: Insert type attachments with pull out and shear capacities appropriate for supported loads and building materials where used.

2.03 HANGER SPRING AND NEOPRENE (HSN) ISOLATORS

A. HSN Vibration Isolation Hangers: free standing and laterally stable steel spring and a neoprene element in series, contained within a steel housing. Spring diameter and hanger housing lower hole sizes large enough to permit hanger rod to swing through a 30 degree arc before contacting housing. Alternatively, make other provisions to allow for a 30 degree arc movement of bottom hanger rod without contacting isolator housing.

B. Spring diameter not less than 0.8 OD compressed height of spring at rated load; minimum spring additional travel-to-solid equal to 50% of rated deflection. Design neoprene element with a 0.3 inch minimum static deflection. Include deflection of both spring element and neoprene element in determining overall deflection of Type HSN isolators.

2.04 IDENTIFYING DEVICES AND LABELS

A. Plastic Duct Markers: Manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:

1. Yellow/Green: Supply air.
2. Blue: Exhaust, outside, return, and mixed air.
3. Nomenclature: Include following:
   - Direction of air flow.
   - Duct service (supply, return, exhaust, etc.)
   - Duct origin (from).
   - Duct destination (to).
   - Design CFM.

B. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semi-rigid snap-on, color-coded pipe markers, conforming to ASME A13.1.

2.05 INSULATION

A. Duct Glass Fiber Blanket: Schuller "Microlite Type 75" meeting ASTM C553, flexible blanket.

1. 'K' ('ksi') Value: 0.27 at 75 deg F (0.040 at 24 deg C) installed.
2. Density: 0.75 lb/cu ft (12 kg/cu m).
3. Vapor Barrier Jacket: FSK, Aluminum foil reinforced with fiber glass yarn and laminated to fire resistant kraft.

B. Piping Glass Fiber: Schuller Micro-Lok meeting ASTM C547; rigid molded, noncombustible.

1. 'K' ('ksi') Value: 0.23 at 75 degrees F (0.033 AT 24 degrees C)
2. Maximum Service Temperature: AP-T PLUS White kraft reinforced with glass
3. fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP jacket with outward clinch expanding staples or vapor barrier mastic as needed.

C. Flexible close cell insulation for condensate drain piping.

2.06 PIPING

A. Copper pipe type "L" w/ wrought copper fittings: Subject to compliance with requirements, provide products from one of the following:

1. Allied Tube and Conduit, A Grinnell Co.
2. American Ductile Iron Pipe, Div. Of American Cast Iron Pipe Co.
3. Grinnell Corp.
4. Stockham

B. Flow Balancing Valves: Subject to compliance with requirements, provide products from one of the following:

1. "Circuit Setter", Bell & Gossett, Inc.
2. "Circuit Setter", Taco, Inc.

C. Air Vents (manual and automatic): Subject to compliance with requirements, provide products from one of the following.

1. Armstrong Machine Works.
2. Bell & Gossett ITT; Fluid Handling Div.
3. Hoffman Specialty ITT; Fluid Handling Div.

2.07 DUCT MATERIALS

A. Sheet metal, general: Provide sheet metal in thickness in accordance with SMACNA "HVAC Duct Construction Standards-Metal and Flexible", Second Edition (1995). For indicated pressure classification, and for the configuration shown on drawings. Package and mark as specified in ASTM A 700.

B. Galvanized Sheet Steel: Lock-formed quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for surfaces of ducts exposed to few.

C. Reinforcement Shapes and Plates: Unless Otherwise indicated, provide galvanized steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for all other ducts.

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

E. Hangers: Galvanized, sheet steel, or round, threaded steel rod. Straps and Rod Sizes: Comply with SMACNA "HVAC Duct Construction Standards - Metal and Flexible," Second Edition (1995), for sheet steel width and gage and steel rod diameters.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Duct Pressure Classification: Classify supply ductwork for variable air volume systems up to the inlet side of the variable air volume terminals as medium pressure and construct for a minimum of 6" wg positive static pressure. Seal Class A, Leakage Class 6 for rectangular ductwork and Class 3 for round ductwork. Classify all other ductwork not listed above for a minimum 2 inch wg positive or negative static pressure.

H. Duct Fabrication: Except as otherwise indicated, fabricated ducts, elbows, transitions, offsets, branch connections and other construction with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible," Second Edition (1995). Comply with the requirements for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

I. Duct dimensions indicated on drawings are inside clear dimensions.

J. Round Ducts: Fabricate round ducts with spiral lock seam construction. Comply with SMACNA "HVAC Duct Construction Standards - Metal and Flexible", Second Edition (1995), and with metal thickness specified for longitudinal seam straight duct.

2.08 DUCT AND CASING LINER

A. Materials: ASTM C 1071, Type II, with coated surface exposed to air stream to prevent erosion of glass fibers.

1. Thickness: 1 inch.
2. Density: 1-1/2 pounds.
3. Thermal Performance: "K-Factor" equal to 0.28 or better, at a mean temperature of 75 deg F.
4. Fire Hazard Classification: Flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM C 411.
5. Liner Adhesive: Comply with NFPA Standard 90A and ASTM C 916.
6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
   - Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into air stream.
   - Adhesive for Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

B. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Apply adhesive to liner facing in direction of airflow not receiving metal nosing. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally. Secure transversely oriented liner edges facing the air stream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at intervals of lined duct preceding unlined duct.

2.09 DUCT SEALANT

A. Joint and Seam Tape: 2 inches wide, glass-fiber fabric reinforced.

B. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral acrylic/silicone activator to react exothermically with tape to form a hard, durable, airtight seal.

C. Joint and Seam Sealant: All purpose industrial grade indoor/outdoor, water based sealant complying with ASTM C 731, ASTM C 732 and ASTM D 2202; formulated with a minimum of 63 percent solids.

D. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.10 VOLUME DAMPERS

A. Multiple or single blade, parallel or opposed blade design as indicated, standard leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications.

1. Aluminum Frames: Hat shaped, 0.010 inch thick, 6063T extruded aluminum channels; frames with flanges where indicated for attaching to walls; flangeless frames where indicated for installation ducts.
2. Extruded Aluminum Blades: 0.050 inch thick 6063T extruded aluminum.
3. Blade Axles: Galvanized steel.
4. Tie Bars and Brackets: Aluminum.
5. Extension for duct wrap and quadrant.

2.11 TURNING VANES

A. Fabricate turning vanes according to SMACNA "HVAC Duct Construction Standards - Metal and Flexible", Second Edition (1995), figures 2-3 and 2-4. Provide turning vanes in all 90 deg. elbows

2.12 FLEXIBLE DUCT

A. General: Comply with UL 181, Class 1.

B. Flexible Ducts - Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2 inch thick, glass fiber insulation around a continuous inner liner.

1. Reinforcement: Steel wire helix encapsulated in the inner liner.
2. Inner Liner: Tri-laminate of Aluminum foil and Aluminum polyester
3. Outer Jacket: Polyethylene film.
4. Maximum Length: 5 feet, pre-stretched.

C. Flexible Rigid Ducts - Insulated: Factory fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2 inch thick, glass fiber insulation around a continuous inner liner.

1. Flexible rigid duct shall be made from a tape of dead soft aluminum sheet, spiral wound into a tube and spiral corrugated. Similar to Buckley "Flexmaster triple lock buck duct insulated aluminum flexible ducting'.
2. Outer Jacket: Polyethylene film.
3. The flexible duct shall be supported as needed, to provide a sag free installation.
4. All flexible duct shall be individually cartoned and labeled for delivery to the job site.
5. Flexible rigid duct to have a maximum length of 5 feet.

2.13 FIRE DAMPERS

A. General: Dynamic fire dampers, UL labeled to UL Standard 555 "Standard for Fire dampers."

B. Fire Rating: 1-1/2 hours for use in one and two hour walls; 3 hours, for use in 3 hour walls.

C. Frame: Type B with blades out of air stream: fabricated with roll-formed, 21 gauge galvanized steel: with mitered and interlocking corners.

D. Mounting Sleeve: Factory or field installed galvanized, sheet steel.

1. Minimum Thickness: 0.056 inch (16 gage) or 0.138 inch (10 gage) thick as indicated, and length to suit application.
2. Exceptions: omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of the wall or floor, and thickness of damper frame meets sleeve requirements.

E. Mounting Orientation: vertical or horizontal as indicated.

F. Blades: Roll formed, interlocking, 21 gage galvanized, sheet steel. In place of interlocking blades, provide full length, 21 gauge, galvanized steel blade connectors.

G. Fusible Link: Replaceable, 165 deg F.

2.14 DIFFUSERS, REGISTERS AND GRILLES

A. Sizes and pattern numbers shown are for general guidance. Approved Manufacturer and Contractor shall be responsible for proper sizing of diffusers, registers and grilles.

B. Ceiling Compatibility: Provide diffusers, registers and grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support.

C. Supply Diffusers Fabricate of steel with 1, 2, 3 or 4 way blow as indicated. Each side to deliver quantity of air proportional to area served. Round/square/rectangular neck as indicated. Provide multiblade equalizing deflector in neck connection of diffuser. Finish: Factory baked on white enamel to match ceiling grid.

D. Round Supply Diffusers Provide round air diffusers in the sizes and performance ranges specified on drawings. The diffuser shall have four cones, three of which shall be assembled to comprise a completely removable inner cone assembly for purposes of installation. The inner cone assembly bracket shall be constructed of aluminum material and shall provide a hidden adjusting devices to control the air discharge in the full range horizontal and vertical projection pattern. Pattern adjustment shall be accomplished by rotating the inner most cone. Entire diffuser shall have an off white painted finish. Diffuser shall be furnished with an opposed blade volume damper. Registers and Grilles

E. Provide registers and grilles indicated as registers with key operated, multishutter, streamlined contour, opposed blade dampers. Provide registers and grilles indicated as grilles with grille faces only without dampers. Sidewall Supply Outlets: Provide with streamlined, horizontal face bars. Provide turning vanes in ductwork behind registers where indicated or where required. Provide concealed fasteners. Return Air, Relief Air and Exhaust Intakes: Provide with streamlined, horizontal fixed bar grille faces with bars set straight for ceiling installation and set at an angle of 45°, turned down for low sidewall installation and turned up for high sidewall installation. Fabricate of steel with 20 gauge minimum frames and 22 gauge minimum blades, aluminum of equivalent gauges or aluminum extrusions. Provide countersunk screw holes in margin. Finish: Factory applied baked on white enamel to match ceiling grid.

2.15 AUTOMATIC TEMPERATURE CONTROLS

A. Provide a complete standalone microprocessor based electronic Direct Digital Control (DDC) system.

B. Work included:

1. Provide 24-volt control wiring from network DDC controllers to all application specific controllers, local display devices through end control devices, comply with requirements of Division 16.
2. Contractor to provide power supply wiring from closet spare breaker at electrical panel to the power connection. Contractor is responsible for providing all necessary electrical components including power distribution wiring, disconnects, breakers, etc. for a complete control system.
3. Provide damper actuators, sensors and relay communications ports between packaged units.
4. Provide 24 volt power damper actuators, including control wiring to the control panels.
5. Provide interlock wiring from duct mounted smoke detectors to auxiliary contacts on the unit starter, and control wiring to DDC system.
6. Transformers, where required, to match control voltage with actuator sensor voltage.

D. Provide DDC control products in sizes and capacities indicated, consisting of dampers, sensors, controllers, temperature sensors, thermostats, wiring, switches, relays, transformers, and other components as required for complete installation. Provide manufacturer's standard materials and components and published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

NORTH

SMMA
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OWNER REVIEW

NAME	DATE

NO.	DATE	DESCRIPTION
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449 Forest Avenue
Portland, ME 04101-2029

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PROJ. ARCH. / ENGR.	EJL
PROJ. MGR.	PJB
JOB NO.	08018.00

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