SECTION 230554

DUCT AND EQUIPMENT IDENTIFICATION

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Mechanical Painting: Section 099103.

1.02 DELIVERY, STORAGE AND HANDLING

A. Deliver paint to the Site in original, new unopened containers, bearing manufacturers' printed labels.

B. Store materials at the site where directed. Keep storage space clean and accessible to the Owner at all times.

PART 2 PRODUCTS

2.01 MATERIALS

A. Paint: Type IAL-3 specified in Section 099103.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection: Cover and protect surfaces to be painted, adjacent surfaces not to be painted, and removed furnishings and equipment from existing paint removals, airborne sanding particles, cleaning fluids and paint spills using suitable drop cloths, barriers and other protective devices.

1. Schedule and coordinate surface preparations so as not to interfere with work of other trades or allow airborne sanding dust particle to fall on freshly painted surfaces. Do not perform the Work of this Section until testing, insulation and finish painting Work have been completed.
2. Provide adequate natural or mechanical ventilation to allow surfaces to be prepared and painted in accordance with product manufacturer's instructions and applicable regulations.
3. Provide and maintain "Wet Paint" signs, temporary barriers and other protective devices necessary to protect prepared and freshly painted surfaces from damages until Work has been accepted.

B. Clean and prepare surfaces to be painted in accordance with specifications, paint manufacturer's approved product data sheets and printed label instructions. In

the event of conflicting instructions or directions, the more stringent requirements shall apply.

1. Cleaners: Use only approved products manufactured or recommended by finish paint manufacturer. Unless otherwise recommended by cleaner manufacturer, thoroughly rinse with clean water to remove surface contaminants and cleaner residue.

3.02 DUCT IDENTIFICATION

A. Identify exposed ductwork, bare or insulated, directly connected to air handling apparatus, in the following spaces or rooms, by means of painted stenciled legends:
   1. Mechanical Equipment.
   2. Steam Service.
   3. Refrigeration Machine.
   4. Boiler.
   5. Penthouse.
   6. Power House.

B. Locate stenciled legends to be readily visible from any point of observation. Stencil identification along center line of duct, close to equipment. Where view is unobstructed from two directions, apply two sets of stenciling (both sides), visible from each direction.

C. Letter Size: 1-1/2 inches in height.

D. Samples of Ductwork Identification:
   1. Fresh Air Supply.
   2. Air Cond. Supply Air.
   3. Air Cond. Return Air.
   4. Recirc. Cond. Air.
   5. Exhaust Air.

E. Colors: Paint stenciled letters black. Where the background color is dark, paint background white before stenciling.

3.03 EQUIPMENT IDENTIFICATION

A. Identify mechanical equipment, bare or insulated, installed in the following spaces or rooms, by means of painted stenciled legends:
   1. Mechanical Equipment.
   2. Steam Service.
   3. Refrigeration Machine.
   4. Boiler.
   5. Penthouse.
   6. Power House.

B. Paint stenciled legends black, a minimum of 1-1/2 inches in height, located to be readily visible from a reasonable point of view. Place identification along center line of equipment, if possible.

C. Samples of Equipment Identification:
   1. Air Cond. Unit AC 1.
   2. Supply Fan S 1.
   3. Exhaust Fan E 1.
   4. Return Fan R 1.

3.04 APPLICATION OF PAINT

A. Stencil Painting: Apply with a brush or aerosol type spray can.

3.05 CLEANING

A. Clean adjacent surfaces of paint spatters resulting from the Work of this Section.

END OF SECTION

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SECTION 233113

METAL DUCTWORK

PART 1 GENERAL

1.01 REFERENCES

A. American Conference of Governmental Industrial Hygienists (ACGIH).

B. National Fire Protection Association (NFPA).

C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

1.02 SUBMITTALS

A. Shop Drawings:
1. Layouts for areas in which it may be necessary to deviate substantially from layout shown on the Drawings. Show major relocation of ductwork and major changes in size of ducts. Minor transitions in ductwork, if required due to job conditions, need not be submitted as long as the duct area is maintained.
2. Layout and fabrication details for cooking equipment exhaust ductwork.
3. Layouts of mechanical equipment rooms and penthouses.
4. Details of intermediate structural steel members required to span main structural steel for the support of ductwork.
5. Method of attachment of duct hangers to building construction.
6. Coordinate shop drawings with related contracts prior to submission.

B. Product Data: Material, gage, type of joints, sealing materials, and reinforcing for each duct size range, including sketches or SMACNA plate numbers for joints, method of fabrication and reinforcing.

1.03 QUALITY ASSURANCE

A. SMACNA: Gages of materials, fabrication, reinforcement, sealing requirements, installation, and method of supporting ductwork shall be in accordance with the following SMACNA manuals, unless otherwise shown or specified:
1. HVAC Duct Construction Standards.
2. Round Industrial Duct Construction Standard.
3. Rectangular Industrial Duct Construction Standard.

C. Conform to the applicable requirements of NFPA 90A, 90B, 91, 96, and 101.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sheet Metal:
   1. Aluminum: ASTM B-209, Alloy 3003, Temper H-14.
   2. Copper: ASTM B-370.
   3. Galvanized Steel: ASTM A653, Class LFQ (lock forming quality), coating designation G-90.
   4. Monel: ASTM B-127.
   5. Stainless Steel: AISI Types 302, 304 and 316, as specified.

B. Duct Hangers:
   1. Strap Hangers: Same material as ducts, except that hangers for stainless steel ducts in unfinished spaces may be galvanized steel.
   2. Rod Type Hangers: Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end, with 2 removable nuts each end for positioning and locking rod in place. Unless stainless steel, galvanized or cadmium plated; shop coat with metal primer.

C. Miscellaneous Fasteners and Upper Hanger Attachments:
   1. Sheet Metal Screws, Machine Bolts and Nuts: Same material as duct, unless otherwise specified.
   2. Concrete Inserts: Steel or malleable iron, galvanized; continuously slotted or individual inserts conforming with MSS SP-58, Types 18 & 19, Class A-B.
   3. C Clamps: Fee & Mason Co.'s 255L with locking nut, and 255S with retaining strap.
   4. Metal Deck Ceiling Bolts: B-Line Systems, Inc.'s Fig. B3019.
   5. Welding Studs: Erico Fastening Systems, capacitor discharge, low carbon steel, copper flashed.
   6. Structural (carbon) Steel Shapes and Steel Plates: ASTM A36, shop primed.
   7. Stainless Steel Shapes and Plates: ASTM A276 and ASTM A666.
   8. Machine Bolt Expansion Anchors:
      a. Non-caulking single unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 1.
      b. Non-caulking double unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 2.
      c. Self-drilling type: FS FF-S-325, Group III, Types 1 and 2.

2.02 FABRICATION - GENERAL

A. Fabricate ductwork from galvanized sheet metal, except as follows:
   1. Fabricate the following ductwork from aluminum:
      a. Inlet and discharge ductwork connected to cooling towers and evaporative condensers.
      b. Exhaust ductwork from shower, locker, can washing and steam service rooms and swimming pool areas.

2. Fabricate the following ductwork from stainless steel:
   a. Supply, return, and recirculated air ductwork connected to inlet or outlet devices installed in surgical operating, surgical scrub-up, surgical recovery and surgical work rooms. Use AISI Type 302 or 304 stainless steel.
   b. Exhaust ductwork connected to cooking equipment, dishwashing, and other scullery equipment hoods. Install stainless steel from the individual hood to its respective fan and from the fan to the point of discharge to the outside air. Use AISI Type 302 or 304 stainless steel.
   c. Exhaust ductwork connected to laboratory exhaust fume hoods. Install stainless steel from the individual hood to its respective fan and from the fan to the point of discharge to the outside air. Use AISI Type 316 stainless steel.
   d. Use stainless steel with a No. 4 finish where installed exposed in finished rooms and No. 2B finish in other locations. Use stainless steel fasteners for ductwork installed exposed in finished rooms and where fastener penetrates duct. Galvanized fasteners may be used in unfinished spaces for non-penetrating service.

B. Dissimilar Metals: Separate dissimilar metals used for ductwork with 12 oz vinyl coated woven fiberglass duct connector fabric, such as Duro Dyne's Glasseal. No separation is required between screws or rivets and the materials in which they are inserted.

2.03 FABRICATION OF STAINLESS STEEL DUCTS

A. Use minimum No. 18 gage for exhaust ducts connected to cooking equipment hoods. Use minimum No. 20 gage for exhaust ducts connected to other hoods.

B. Use stainless steel reinforcing members for ducts in finished spaces and galvanized steel in unfinished spaces.

C. Longitudinal Seams For Dishwashing, and Other Scullery Equipment Exhaust Ducts: Form double corner seams, or Pittsburgh lock seams.
   1. Fabricate elbows and transitions with Pittsburgh lock seams.
   2. Fabricate double compounded elbows and other complex fittings with double corner seams.
   3. Locate seams in horizontal ducts at top corners of ducts, unless otherwise approved in writing.
   4. Locate seams in vertical ducts at rear corners of ducts.

2.04 REGISTERS AND GRILLES INSTALLED IN EXPOSED DUCTWORK

A. Frames are not required for registers and grilles installed directly in uninsulated exposed ductwork.

B. Cut openings in ducts, forming a double thickness of metal, to attach registers or grilles with sheet metal screws. Bend back edges of openings into duct, on all 4

sides, a minimum of 1 inch to provide the thickness of metal stated above. Provide felt or sponge rubber gasketing, all 4 sides of duct openings, for supply grilles and supply registers.

2.05 AIR DIFFUSERS INSTALLED IN EXPOSED DUCTWORK

A. Frames are not required for diffusers installed directly in uninsulated exposed ductwork.

B. Cut and form openings in ducts, to accommodate the specified volume control damper and adjustable equalizing grid assembly. Reinforce openings as required and approved. Provide felt or sponge rubber gasketing, around duct opening, for supply diffuser assemblies.

2.06 VIBRATION ISOLATION FOR DUCTWORK

A. Type: Combination rubber and spring type designed for insertion in a split hanger rod for isolating ductwork from the overhead construction.
   1. Approved isolators: Amber Booth Type BSSR, Korfund Type VX, Mason Industries, Type DNHS, Vibration Eliminator Co. Type SNRC and Vibration Mountings and Controls Type RSH.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install ductwork to allow maximum headroom. Properly seam, brace, stiffen, support and render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved, if cross sectional area is maintained.

B. Pitch horizontal ducts connected to hoods downward toward hood not less than 1 inch in 10 feet.

C. Provide necessary transformation pieces, and flexible fabric connections for ductwork connected to air handling equipment or air inlet and outlet devices.

3.02 SEALING SEAMS, JOINTS, AND PENETRATIONS

A. Seal ductwork in accordance with the SMACNA Manual except for the following:
   1. Ductwork Specified to be Insulated: Conform with Seal Class A for all pressure classes.
   2. Cooking Equipment Exhaust Ductwork: Conform with NFPA 96.
   3. Horizontal Ductwork for Dishwashing, and Other Scullery Equipment Exhausts:
      a. Continuously solder transverse joints vaportite along bottom, and up both sides 2 inches minimum.

b. Continuously solder longitudinal seams vaportite if seams are approved to be located at bottom of duct.

3.03 HANGERS FOR DUCTS, UNDER 2 INCHES W.G.

A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:
   1. Rectangular ducts up to 42 inches wide, not having welded or soldered seams, and supported from overhead construction; extend strap hangers down over each side of the duct and turn under bottom of duct a minimum of 2 inches. Secure hanger to duct with 3 full thread sheet metal screws, one in the bottom and 2 in the side of the duct.
   2. Rectangular ducts 43 inches wide and over, and all sizes of duct with welded or soldered seams, and supported from overhead construction; use trapeze hangers.
   3. Prime coat plain steel rods threaded at the site immediately after installation with metal primer.

3.04 HANGERS FOR DUCTS, 2 INCHES W.G. AND OVER

A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:
   1. Support rectangular ducts, regardless of size, by means of trapeze hangers, framed all four sides. Provide minimum 1 x 1 x 1/8 inch angle iron framing for duct having a maximum side dimension up to and including 36 inches in size. Install framing snug to all four sides of duct.

3.05 UPPER HANGER ATTACHMENTS

A. General:
   1. Secure upper hanger attachments to structural steel or steel bar joists wherever possible.
   2. Do not use drive-on beam clamps, flat bars or bent rods, as upper hanger attachments.
   3. Do not attach hangers to steel decks which are not to receive concrete fill.
   4. Do not attach hangers to precast concrete planks less than 2-3/4 inches thick.
   5. Avoid damage to reinforcing members in concrete construction.
   6. Metallic fasteners installed with electrically operated or powder driven tools may be used as upper hanger attachments, in accordance with the SMACNA Manual, with the following exceptions:
      a. Do not use powder driven drive pins or expansion nails.
      b. Do not attach powder driven or welded studs to structural steel less than 3/16 inch thick.
      c. Do not support a load, in excess of 250 lbs from any single welded or powder driven stud.
      d. Do not use powder driven fasteners in precast concrete.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by ductwork support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of 5.
   1. Secure upper hanger attachments to steel bar joists at panel points of joists.
   2. Do not drill holes in main structural steel members.

C. Attachment to Concrete Filled Steel Decks:
   1. New Construction: Install metal deck ceiling bolts.
   2. Existing Construction: Install welding studs (except at roof decks).
   3. Do not attach hangers to decks less than 2-1/2 inches thick.

D. Attachment to Existing Cast-In Place Concrete:
   1. Secure hangers to overhead construction with self drilling type expansion anchors and machine bolts.
   2. Secure hanger attachments required to be supported from wall or floor construction with single unit expansion anchors or self drilling type expansion anchors and machine bolts.

E. Attachment to Cored Precast Concrete Decks (Flexicore, Dox Plank, Spancrete, etc.): Toggle bolts may be installed in cells for the support of ducts up to a maximum of 60 inches in width.

F. Attachment to Hollow Block or Hollow Tile Filled Concrete Decks:
   1. New Construction: Omit block or tile and pour solid concrete with cast-in-place inserts.
   2. Existing Construction: Break out block or tile to access, and install machine bolt anchors at highest practical point on side of web.

G. Attachment to Waffle Type Concrete Decks:
   1. New Construction: Install cast-in-place inserts.
   2. Existing Construction: Install machine bolt expansion anchors at highest practical point on side of web.

H. Attachments to Precast Concrete Tee Construction:
   1. Secure hangers to tees by any of the following methods:
      a. Tee hanger inserts between adjacent flanges.
      b. Install double unit expansion anchors and machine bolts at highest practical point on side of web.

I. Attachment to Wood Construction:
   1. Secure strap hangers to the sides of wood beams with one No. 18 x 1-1/2 inch long (minimum) wood screws or 2 No. 16 x 1-1/2 inch long (minimum) drive screws. Do not hammer in wood screws.
   2. Secure rod hangers to angle iron clip angles, bolted or screwed to the sides of the wood beams with 3/8 inch bolts or 3/8 inch lag screws. Install hanger rods with a threaded end through a hole in the angle, secured with a double nut, one above and one below the angle. Do not use lag screws in wood beams, having a nominal face width under 2

inches. Install bolts or lag screws in the side of beams at mid-point or above.

3. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
4. Where wood trusses are approved to support ductwork, hangers may be attached only to the bottom chord. Method of attachment must be specifically approved.
5. Do not secure hanger attachments to nailing strips resting on top of steel beams.

3.06 DUCT RISER SUPPORTS, UNDER 2 INCHES W.G.

A. Support vertical round ducts by means of double-ended split steel pipe riser clamps bearing on floor slabs or adjacent structural members, at every other floor through which the riser passes.

B. Unless otherwise specified or shown on the drawings, support vertical rectangular ducts by means of two steel angles, secured to duct and resting on floor slab or adjacent structural steel member, at every other floor through which the duct passes. Size supports as follows:

MAX. SIDE DIMENSION (inches)	SUPPORT ANGLE (inches)	SECURE TO DUCT WITH	MIN BEARING AT EACH END (inches)
36	1 x 1 x 1/8	Screws	2
48	1-1/2 x 1-1/2 x 1/8	Bolts	3
60	2 x 2 x 1/8	Bolts	3
61 - up	2-1/2 x 2-1/2 x 3/16	Bolts	4

3.07 DUCT RISER SUPPORTS, 2 INCHES W.G. AND OVER

A. Support vertical round ducts by means of double-ended split steel pipe riser clamps welded to the ducts and bearing on floor slabs or adjacent structural members, at every other floor through which the riser passes.

B. Support vertical rectangular ducts by means of two steel angles or channels, anchor bolted to floor slab or adjacent structural member at every other floor through which the riser passes. Secure steel angles or channels to a transverse joint by means of 3/8 inch bolts, or by welding. Size supports as follows:

MAXIMUM SIDE DIMENSION (inches)	SUPPORT ANGLE (inches)	SUPPORT CHANNEL (inches)	MINIMUM BEARING AT EACH END (inches)
36	1 x 1 x 1/8	1 x 1/2 x 1/8	2
48	1-1/2 x 1-1/2 x 1/8	1-1/2 x 3/4 x 1/8	3
60	2 x 2 x 1/8	2 x 1 x 1/8	3
61 - up	2-1/2 x 2-1/2 x 3/16	2 x 1 x 3/16	4

MAXIMUM SIDE DIMENSION (inches)	SUPPORT ANGLE (inches)	SUPPORT CHANNEL (inches)	MINIMUM BEARING AT EACH END (inches)

3.08 VIBRATION ISOLATION FOR DUCTWORK

A. Install vibration isolation in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. High Velocity Ductwork Installed within Mechanical Equipment, Machine and Penthouse Mechanical Equipment Rooms: Provide combination rubber and spring type isolators, designed for insertion in a split hanger rod for overhead supported ductwork and double rubber-in-shear isolators for floor supported ductwork. Provide isolators designed for a static deflection of 1/2 inch.

END OF SECTION

SECTION 233300

DUCTWORK ACCESSORIES

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Metal Ductwork: Section 233113.

1.02 REFERENCES

A. ACGIH: American Conference of Governmental Industrial Hygienists.

B. AMCA: Air Movement and Control Association.

C. NFPA: National Fire Protection Association.

D. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.

E. UL: Underwriters Laboratories, Inc.

1.03 SUBMITTALS

A. Product Data: Catalog sheets, diagrams, standard schematic drawings, and installation instructions for each manufactured product. Submit SMACNA Figure Numbers for each shop fabricated item.

B. Samples: When directed, submit one complete unit for each type of proposed air inlet and outlet device. Approved samples will be delivered to the job site for installation.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Unless otherwise shown or specified, comply with the applicable requirements of the following:

      a. SMACNA: Gages of materials, fabrication, sealing, and installation shall be in accordance with the SMACNA Manuals.
         1) HVAC Duct Construction Standards.
         2) Round Industrial Duct Construction Standard.
         3) Rectangular Industrial Duct Construction Standard.
      b. ACGIH: Follow the Hood Design Data, and Construction Guidelines for Local Exhaust Systems from the Industrial Ventilation Manual.
      c. AMCA: Certify damper and/or louver ratings in accordance with AMCA 511.
      d. NFPA: Standards Nos. 90A, 90B, 91, 96, and 101.

e. UL: Standards No. UL181, UL555, and UL555S.

1.05 MAINTENANCE

A. Special Tools:
1. One bar deflection key for every five supply grilles and/or every five return grilles.
2. One operator key for every five supply registers and/or every 5 return or exhaust registers.
3. Two keys or socket wrenches for each type of damper adjustment screw or device on manual damper regulators.
4. One tool for each type and size security fastener.

PART 2 PRODUCTS

2.01 GRILLES AND REGISTERS

A. Unless otherwise specified, fabricate grille and register faces, and frames of steel with factory applied white baked-on enamel.

B. Fabricate grille, register faces, and frames of aluminum with an etched and acrylic coated finish when installed in shower, can washing, dishwashing, food serving and dining rooms, kitchens and swimming pool areas.

C. Fabricate grille and register faces, and frames of Type 302 or 304 stainless steel, with a No. 4 finish when installed in surgical operating, surgical scrub-up, surgical recovery and surgical work rooms.

D. Supply Grilles: Adjustable, double deflection type.
1. Grille Face: 20 gage construction of same material as bars/vanes.
2. Face and Rear Bars/Vanes: Installed in grille face.
a. Bars/vanes individually adjustable and front pivoting to any desired setting by means of bar deflection key.
b. Nominal Bar/Vane Spacing: 0.66 inch or 0.75 inch on center.

E. Exhaust or Return Grilles: Fixed, single deflection type.
1. Grille Face: 20 gage construction of same material as bars/vanes.
2. Face Bars/Vanes: Installed in grille face.
a. Deflection Angle: 20 to 55 degrees.
b. Nominal Bar/Vane Spacing: 0.66 inch or 0.75 inch on center.
c. Sidewall grilles shall have horizontal face bars/vanes.

F. Supply Registers: Adjustable, double deflection type.
1. Register Face: 20 gage construction of same material as bars/vanes.
2. Face and Rear Bars/Vanes: Installed in register face.
a. Bars/vanes individually adjustable and front pivoting to any desired setting by means of bar deflection key.
b. Nominal Bar/Vane Spacing: 0.66 inch or 0.75 inch on center.

3. Damper Assembly: Opposed multi-blade type consisting of frame, blades, and key operated movement of the locking type.
   a. Operators: Key operated type projecting through frame or screwdriver slot. Operator keys are removable or may be permanently driven in place, as directed.
   b. Construction:
      1) For use with Aluminum or Stainless Steel Register Faces: Aluminum with etched or acrylic finish.

      2) For use with Factory Painted Register Faces: Galvanized steel factory finished with baked on black enamel, unless otherwise approved by the Owner.

G. Exhaust or Return Registers: Fixed single deflection type.
   1. Register Face: 20 gage construction of same material as bars.
   2. Face Bars/Vanes: Installed in register face.
      a. Deflection Angle: 20 to 55 degrees.
      b. Nominal Bar/Vane Spacing: 0.66 inch or 0.75 inch on center.
      c. Sidewall registers shall have horizontal face bars/vanes.
   3. Damper Assembly: Opposed multi-blade type consisting of frame or screwdriver slot blades, and key operated movement of the locking type.
      a. Operators: Key operated type projecting through frame or screwdriver slot. Operator keys are removable or may be permanently driven in place, as directed.
      b. Construction:
         1) For use with Aluminum or Stainless Steel Register Faces: Aluminum with etched or acrylic finish.

         2) For use with Factory Painted Register Faces: Galvanized steel factory finished with baked on black enamel, unless otherwise approved by the Owner.

H. Mounting Frames for Registers and Grilles:
   1. Fabricated from a minimum of No. 20 USS gage stamped or rolled steel, or extruded aluminum, to match material and finish of mating grille or register face.
      a. Weld exposed joints and ground flush.
      b. Completely close corner joints with neatly welded backtrim.
      c. Furnish frames complete with felt or sponge rubber gaskets on all four sides, except when frames are used as plaster stops.

2.02 AIR DIFFUSERS

A. Unless otherwise specified, fabricate diffusers of steel with factory-applied finish as follows:
   1. Prime coat for installation in walls and gypsum board, hard plaster or acoustic plaster ceilings specified to be painted.
   2. Baked-on white enamel for installation in splined acoustic ceilings, metal pan ceilings and suspended lay-in tile ceilings.

B. Fabricate diffusers of aluminum with an etched and clear acrylic coated finish where installed in shower, can washing, dishwasher, food serving and dining rooms, kitchens, swimming pool areas, surgical operating, surgical scrub-up, surgical recovery and surgical work rooms.

C. General:
1. Roll or round and reinforce all exposed edges of diffusers.
2. Internal diffuser parts shall be readily removable to permit cleaning and access to ducts.
3. Design removable parts and assemblies so that they cannot be reassembled in a manner that would produce an incorrect air distribution pattern.
4. Secure internal assemblies with fasteners that allow removal without use of special tools.
5. Do not use neck or duct connection sizes indicated to size diffusers.

D. Circular, Square and Rectangular Diffusers:
1. Complete with volume control damper and adjustable equalizing grid, fabricated of same material and with same finish as diffuser.
2. Damper shall be adjustable by means of operator handle and rod device, which is designed to be locked in any position , and is operable from diffuser face.
3. Diffusers installed in plaster ceilings shall have plaster grounds of same material and finish as diffuser.
4. Institutional Air Diffusers: Fixed stationary type with 18 gage perforated face plate welded to frame, and 3/16 inch holes on 1/4 inch staggered centers.
   a. Supply Diffusers: 4-way deflection.
   b. Return diffusers: No deflection.

E. Linear Diffusers:
1. Complete with opposed blade flow equalizing damper that is adjustable to any desired setting, and fabricated of same material and with same finish as diffuser.
2. Damper operable from diffuser face.

2.03 DAMPERS

A. Control Dampers (Galvanized Steel):

1. Types:

   a. Standard Damper: 40 cfm/sq ft maximum leakage rate at 1500 fpm and 1 inch wg for 48 inch wide damper (based on AMCA 500).
   b. Low Leakage Damper: 3.7 cfm/sq ft maximum leakage rate at 1500 fpm and 1 inch wg for 48 inch wide damper (based on AMCA 500).

2. Frame: 16 gage galvanized steel hat channel with corner braces, and welded joints.
   a. Frame Size:
      1) Dampers 13 inches high and under: 3-1/2 inch x 3/8 inch top and bottom frames.
      2) Dampers over 13 inches high: 5 inch x 1 inch.
3. Blades:
   a. Standard Damper: Single skin, 16 gage galvanized steel with longitudinal reinforcing grooves. Single blade dampers are acceptable for ducts up to 14 inches high.
   b. Low Leakage Damper: Single skin, 16 gage galvanized steel with longitudinal reinforcing grooves, and PVC coated polyester blade edge seals mechanically locked into blade edge.
   c. Blade Action:
      1) Modulating Dampers: Opposed blade.
      2) Fully Open/Fully Closed Dampers: Parallel blade.
      e. Single blade dampers are acceptable for ducts up to 14 inches high.
4. Axles: 1/2 inch plated steel hex positively locked to blade, and connected to frame through extruded hole with molded synthetic sleeve bearings.
5. Extended Shaft Assembly: Consisting of outboard support bracket, extended shaft rod, extended shaft.
   a. Suitable for 2 inches of insulation.
6. Jamb Seals: Flexible metal compression type.
7. Damper Operation:
   a. Standard Damper: Manually operated by lockable hand quadrant.
   b. Low Leakage Dampers: Electric motor operated. Weld actuator mounting bracket to frame.
8. Linkage:
   a. Single Section Dampers: In-frame fixed type with removable 1/2 inch dia control shaft extending 6 inches from damper frame, and outboard support bearing.
   b. Multiple Section Dampers: On-blade fixed type with factory installed jackshaft.
9. Finish: Mill galvanized.

B. Control Dampers (Aluminum):
1. Types:
   a. Standard Damper: 3.2cfm/sq ft maximum leakage rate at 2000 fpm and 1 inch wg for 48 inch wide damper (based on AMCA 500).
   b. Low Leakage: 2.7 cfm/sq ft maximum leakage rate at 4000 fpm and 1 inch wg for 48 inch wide damper (based on AMCA 500).
2. Frame: Extruded aluminum hat channel, 1/8 inch thick, and mounting flanges, and welded joints.
   a. Frame Size:

1) Dampers 12 inches high and under: 5 inches x 1/2 inch top and bottom frames.
2) Dampers over 12 inches high: 5 inches x 1 inch

3. Blades:
   a. Standard Damper: Constructed of 1/8 inch thick extruded aluminum with replaceable extruded vinyl double edge blade seals mechanically locked into extruded blade slots.
   b. Low Leakage Damper: Airfoil type constructed of 0.71 thick extruded aluminum, with integral reinforcing tube running full length of blade, and replaceable extruded vinyl double edge blade seals mechanically locked into extruded blade slots.
   c. Blade Action:
      1) Modulating Dampers: Opposed blade.
      2) Fully Open/Fully Closed Dampers: Parallel blade.
   d. Single blade dampers are acceptable for ducts up to 14 inches high.
4. Axles: 1/2 inch plated steel hex positively locked to blade and connected to frame through extruded hole with molded synthetic sleeve bearings.
5. Extended shaft Assembly: Consisting of outboard support bracket, extended shaft rod, and extended shaft.
   a. Suitable for 2 inches of insulation.
6. Jamb Seals: Flexible metal compression type.
7. Damper Operation:
   a. Standard Damper: Manually operated by lockable hand quadrant.
   b. Low Leakage Dampers: Electric motor operated. Weld actuator mounting bracket to frame.
8. Linkage:
   a. Single Section Dampers: In-frame fixed type with removable 1/2 inch dia control shaft extending 6 inches from damper frame.
   b. Multiple Section Dampers: On-blade fixed type with factory installed jackshaft.
9. Finish: Mill.

C. Insulated Control Dampers:
1. Frame: 16 gage galvanized steel hat channel, minimum 4 inches wide, with corner braces, and welded joints.
2. Blades: Double skin, 16 gage galvanized steel insulated with one inch thick fiberglass, with vinyl edge seals, and longitudinal reinforcing grooves.
3. Blade Action:
   a. Volume Control Dampers: Opposed blade.
   b. Fresh Air and Make-up Air Control Dampers Interlocked with Exhaust Fans: Parallel blade.
4. Axles: Minimum 7/16 inch plated steel hex positively locked to blade, and connected to frame through extruded hole with molded synthetic sleeve bearings.

5. Extended Shaft Assembly: Consisting of outboard support bracket, extended shaft rod, extended shaft.
   a. Suitable for 2 inches of insulation.
6. Jamb Seals: Flexible metal compression type.

7. Damper Operation: Electric motor operated. Weld actuator mounting bracket to frame.
8. Linkage:
   a. Single Section Dampers: In-frame fixed type with removable 1/2 inch dia control shaft extending 6 inches from damper and outboard support bearing.

   b. Multiple Section Dampers: On-blade fixed type with factory installed jackshaft.

9. Finish: Mill galvanized.

D. Fire Dampers, Dynamic Systems:
1. UL Classified and Labeled:
   a. Mark dampers in accordance with UL555, including but not limited to the following:
      1) Fire Damper, 1-1/2 hr fire resistance rating.
      2) For use in dynamic systems.
      3) Maximum rated air flow and pressure difference across damper.
      4) Directional arrow indicating air flow.
      5) Mounting position (horizontal or vertical, or both).
2. Acceptable Manufacturers:
   a. Air Balance, Inc., or Ruskin Manufacturing Div., Phillips Industries.
      1) Furnish Style, or Type B (blades out of air stream when damper in open position).

E. Multiple Blade Type Combination Fire/Smoke Dampers:
1. UL Classified and Labeled:
   a. Fire Resistance Rating 1-1/2 hr.
2. Actuator: Electric motor with fusible link override.

F. Manual Damper Regulators:
1. For Dampers Installed in Exposed, or Accessible Concealed Ductwork: Indicating quadrant with heavy metal handle, end bearing, and means for locking damper in all positions.
2. For Dampers Installed in Inaccessible Concealed Ductwork: Concealed type with indicating regulator in cast metal box with cover plate. Furnish assembly complete with duct end bearing, adjustment coupling, and damper extension rods.

2.04 COMBINATION DAMPERS AND LOUVERS

A. Construction: Extruded 6063T5 aluminum, with the following:
1. Frame: 6 inches deep x 0.125 inches wall thickness.

2. Front Blades: Stationary, drainable type, 0.081 inches thick. Set blades at 37-1/2 degrees on 4-1/2 inch centers
3. Rear Blades: Adjustable type, 0.125 inches thick.
4. Seals: Vinyl damper blade edge seals and flexible, compressible aluminum jamb seals.
5. Damper Bearings: Stainless steel.
6. Electric motor operator with auxiliary (end) switch on motor.
7. Finish: Clear anodized finish.
8. Bird Screen: Aluminum wire mesh.

2.05 DAMPER ACTUATORS

A. Acceptable Manufacturers: Honeywell Inc., Johnson Controls, Inc., Belimo, and Seimens.

B. Electric/Electronic Type:
1. Positive positioning, spring return, and sized in accordance with actuator manufacturer's printed recommendations for each damper size.
2. Actuators for outdoor dampers shall fail closed upon loss of electric power.
3. Actuator Response: Linear in response to sensed load.
4. Voltage: 120 VAC or 24 VAC.
5. Actuator Timing:
   a. Open Damper: 90 seconds.
   b. Spring Return: 30 seconds.
   c. Spring Close: 30 seconds.

C. Pneumatic Piston Type: Sized in accordance with actuator manufacturer's printed recommendations for each damper size.
1. Operating Pressure: 3-15 psig.
2. Two-way swivel connection on cylinder.
3. Swivel ball joint and slotted crank arm.
4. Universal mounting bracket.

D. Hydraulic, thermodynamic and battery type actuators are not acceptable.

E. Auxiliary End Switches: Required on electric/electronic actuators for the following applications:
1. 100 percent Outside Air Systems: Outside air damper switch delays start of unit until damper is open. Set switch to start unit when damper is 50 percent open.
2. In-line Exhaust Fan Systems (Over 500 cfm): Exhaust damper switch delays start of fan until damper is open.

F. Dampers associated with diesel alternators shall be spring open, power closed.

2.06 TURNING VANE ASSEMBLIES

A. Fabricate vane assemblies of same material as ductwork in which installed.
1. Vanes: Individual hollow airfoil type, rigidly connected to vane rails.

2. Weld, screw, or rivet rails to ductwork.

2.07 FLEXIBLE CONNECTIONS - FABRIC

A. Static Pressures under 6 inches WG: Woven Fiberglass fabric with Hypalon coating; similar to Duro Dyne Corp.'s Durolon.

B. Static Pressures 6 inches and Above: Single ply neoprene reinforced with 14 oz duck fabric; Style 3210 by Uni Rubber Inc., 11 Park Place, New York, NY 10007, (212) 962-0980.
   1. Attach fabric to minimum one inch wide 11 gage stiffener, and seal with duct sealant.

C. Direct Fired Heating Equipment with Temperatures up to 500 Degrees F: Woven fiberglass fabric with silicone rubber coating; similar to Duro Dyne Corp.'s Thermofab.

D. Factory prefabricated and pre-assembled connectors of fabric materials specified above are acceptable with minimum 24 gage galvanized steel edges similar to Duro Dyne Corp.'s Metal-Fab or Super Metal-Fab as required by free fabric length.

2.08 GASKET MATERIAL

A. Registers, Grilles, and Diffusers Installed in Exposed, Uninsulated Ductwork: 1/4 inch thick felt or sponge rubber material, of width as required by flange.

B. Flanged Joints in Ducts: 1/8 inch thick reinforced inert plastic of the self-conforming type, of same width as flange.
   1. Exception: Where flanged connections in cooking equipment exhaust ductwork is allowed by NFPA 96, make up joints with Fibrefrax Grade 110 Paper by Carborundum Co.

2.09 SEALANTS

A. Acceptable Manufacturers: Duro Dyne Corp.; Foster Products Div., H.B. Fuller Co.; Hardcast Inc.; United Sheet Metal Div., United McGill Corp.

B. U.L. Listed adhesives (liquid or mastic), scrim, tapes, or combinations thereof, as required for pressure class; suitable for system operating temperatures; compatible with media conveyed within, insulation (if any), and ambient conditions.

2.10 FLEXIBLE DUCT

A. Conform to NFPA 90A, and UL181 Class I:
   1. Uninsulated Type: Factory assembled duct consisting of continuous, seamless, metalized polyester tear resistant duct with encapsulated steel helix.
   2. Pre-insulated Type: Factory assembled.

a. Internal Core: Continuous material suitable for service, with encapsulated steel helix that completely shields fiberglass insulation from air stream.
b. Outer Vapor Barrier Jacket: Seamless, tear resistant metalized polyester.

3. Operating Conditions:
   a. Maximum Operating Temperature: __200___ degrees F.
   b. Maximum Operating Static Pressure (Positive): ____8____ inch wg.
   c. Maximum Operating Static Pressure (Negative): ____1___ inch wg.
   d. Maximum Air Velocity: __5000___ fpm.
4. Metal Clamps: Stainless steel with cadmium plated hex bolt.

2.11 DUCT ACCESS DOORS

A. Prefabricated or Fabricated at Site: Minimum 12 x 12 inch size, of same material and finish as duct unless otherwise shown or specified.
   1. For uninsulated duct designed for under two inches wg: Fabricate single panel door of same gage as duct, with all edges folded, size door to overlap opening perimeter by one inch.
   2. For insulated duct and duct designed for two inches wg and over: Fabricate hollow metal doors in accordance with the SMACNA Manual. Fill void in doors for insulated duct with thermally equivalent insulation.
   3. Gasketing: A 3/4 inch wide, 1/8 inch thick urethane gasket, around all four sides of duct opening.
      a. Exception: Where access doors are required by NFPA 96 in cooking equipment exhaust ductwork, gasket with Fibrefrax Grade 110 paper by Carborundum Co.

B. Access Door Hardware:
   1. Piano Hinges: Galvanized steel with brass pins, continuous type, full height of door.
   2. Butt Hinges: Galvanized steel with brass pins, approximately 2 inches x 1-9/16 inches wide for doors under 24 inches high and 3 inches x 2 inches wide for doors over 24 inches and higher.
   3. Sash Locks: Galvanized, cadmium plated, or aluminized steel or cast aluminum.
   4. Door Latches: Ventfabrics, Inc. Ventlock No. 260 or Duro Dyne Corp. Code No. SP-20 Series.

2.12 FUSIBLE LINK ATTACHMENTS

A. For Registers and Grilles: Factory installed spring arrangement with 160 degree F rated fusible links.

B. Thermally and Electrically Responsive Links: Air Balance's ETL electrothermal link.

2.13 FASTENERS

A. Security Fasteners: Torx head with center pin.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Unless otherwise shown or specified, install the Work of this Section in accordance with the manufacturer's printed installation instructions and the SMACNA Manual.

3.02 FLEXIBLE FABRIC CONNECTORS (INSTALLATION)

A. Make ductwork connections to air handling equipment with flexible fabric connectors. Install connectors with sufficient slack to prevent vibration transmission.

B. Free Fabric Length: Install fabric connectors a minimum of three inches in length for ducts having a maximum diameter of 18 inches, or maximum side dimension of 30 inches, and a minimum of five inches in length for duct diameters over 18 inches or side dimensions over 30 inches.

C. Secure fabric connectors to fans, casings and ducts as follows:
1. Round Connectors: Secure with No. 12 USS gage x 1 inch wide galvanized steel draw bands. Secure bands with bolts and nuts.

2. Rectangular Connectors: Secure with 1 inch x 1/8 inch thick flat galvanized steel bars, with screws or bolts on maximum 8 inch centers, or with approved sheet metal slip joints. Tightly crimp fabric into sheet metal joint and secure complete joint with sheet metal screws on maximum 6 inch centers.

D. Fabric connectors may be factory pre-fabricated pre-assembled units, with minimum No. 24 USS gage metal edges, secured to fabric with double lock seams.

E. Do not paint fabric connectors.

3.03 ACCESS DOORS

A. Install gasketed access doors in ductwork at each of the following:
1. Major changes of direction in horizontal ducts connected to cooking equipment hoods.
2. Motor operated dampers.
3. Manually operated volume control devices.
4. Fire dampers.
5. Combination fire/smoke dampers.

6. All locations where operating parts of any kind are installed and elsewhere as indicated.
7. In-line damper actuators installed in air stream.

B. Access doors are not required, where a manually operated damper has an exposed damper regulator, with an indicating quadrant.

3.04 CONCEALED DAMPER REGULATORS

A. Imbed box in, and secure to back-up construction in ceiling or wall, so cover plate is flush with final surface.

END OF SECTION

SECTION 238239

UNIT HEATERS

PART 1 GENERAL

1.01 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Deliver the following products to the Electric Contractor for installation and connection to power wiring:
   1. Line voltage thermostats.
   2. Remote mounted speed switches.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Vibration Isolation: Section 230550.
D. Wiring for Motors and Motor Controllers: Section 260523.
E. Motors and Motor Controllers: Section 260221.

1.03 SUBMITTALS

A. Product Data: Catalog cuts, specifications, installation and maintenance instructions for each type of heater specified.

B. Shop Drawings: Detailed dimensional data for outside air intake box assembly.

C. Schedule: List manufacturer, unit type, model number, and performance data for each unit heater.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Unit heaters shall be UL listed.

PART 2 PRODUCTS

2.01 ELECTRIC UNIT HEATERS

A. Provide electric unit heater(s) as specified and scheduled and at the location(s) shown on the Drawings. Each unit heater shall consist of an electric heating element, fan, motor, controls, and all other items and accessories, factory assembled in a sheet steel casing. Casing shall receive a bonderized rust-preventive coating and a finished coat of baked enamel. Controls, provided by the unit manufacturer, shall consist of an automatic temperature controlling sensor (0-10VDC or 4-20mA or RTD or thermister) located at the air intake to the heating element and a fan delay switch that will prevent the fan from starting until the heating element is warm. Integral sensor shall be capable of field

adjustment and shall be set initially at 50°F (no unoccupied setback will occur for units located in crawl spaces or other unoccupied spaces that have pipes subject to possible freezing. Unit heaters for freeze protection located in mechanical rooms shall have occupied/unoccupied setpoint adjustments). Electric unit heaters shall carry the UL or ETL label and shall operate at the voltages and phases as specified on the Drawings. The Electrical Contractor shall provide service wiring to each unit heater.

B. Manufacturers: Unit Heater shall be manufactured by:

Chromalox Co.; Emerson Electric Co
Berko/Q-Mark; Div. of Marley Elec.
Modine Mfg. Co.
Redd-i Products Company, a Division of TPI Corporation
Markel Products; a Division of TPI Corporation

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. The Electrical Contractor shall install electrical devices (line voltage electric thermostats, remote mounted speed switches) furnished by the unit manufacturer but not specified to be factory-mounted and specified. The Electrical Contractor shall verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements. Do not proceed with equipment start-up until wiring installation is acceptable.

C. The Mechanical Contractor shall furnish and install field control devices (thermostats, temperature sensors, control wiring, etc.).

D. The Mechanical Contractor shall verify that the control wiring installation is in accordance with manufacturer's submittal and installation requirements. Do not proceed with equipment start-up until control wiring installation is acceptable.

E. All sensors or thermostats shall be installed min. of 5' 6" AFF.

3.02 PAINTING

A. Finish painting the unit heaters after installation, coordinate color selection with architect.

3.03 ADJUSTING AND CLEANING

A. After construction is completed, including painting, clean unit exposed surfaces, vacuum inside the unit heaters. Retouch any marred or scratched surfaces, using finish materials furnished by the manufacturer.

3.04 INTERDISCIPLINARY TESTS AND FUNCTIONAL PERFORMANCE TESTS

A. Interdisciplinary Pre-Start-Up and Start-Up Tests:

1. The Contractor shall conduct interdisciplinary pre-start up and start up tests as per the manufacturer's start up procedures. Contractor shall submit signed start up affidavit signed by the factory authorized service representative indicating that all of the manufacturer's pre-start up and start up procedures have been successfully completed.

B. Functional Performance Tests:

1. Contractor shall also submit signed functional performance testing affidavit signed by the factory authorized service representative indicating that all of the manufacturer's functional performance tests have been successfully completed.

3.06 FIELD QUALITY CONTROL

A. Instruct and train maintenance personnel in the equipment operations. Secure written confirmation that instruction has been provided and approved maintenance manuals received.

END OF SECTION

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