

SECTION 15890

METAL DUCTWORK AND ACCESSORIES

PART 1 DESIGN DIRECTIVE

1.1 CODES AND QUALIFICATIONS

- A. Firms regularly engaged in manufacture of metal ductwork, products and accessories of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible, Second Edition (1995)" for fabrication and installation of metal ductwork. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for sealing requirements of metal ductwork.
- C. Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems", NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems", and NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations".
- D. Construct, test, and label fire dampers in accordance with UL Standard 555 and 555S, "Fire Dampers and Ceiling Dampers", latest edition.
- E. Comply with the ~~1996 "National Mechanical Code"~~ *currently enforced edition of the International Mechanical Code* for fabrication of metal ductwork.
- F. Test and rate louvers in accordance with AMCA 500, "Test Method for Louvers, Dampers and Shutters".
- G. Comply with the North American Insulation Manufacturer's Association, "Fibrous Glass Duct Liner Standard", First Edition.

1.2 SUBMITTALS

- A. Submit ductwork Fabrication Shop Standards Manual indicating gauges, reinforcing, and similar information for ductwork, fittings, accessories, etc., for the required sizes and static pressure classes to fully demonstrate compliance with SMACNA "HVAC Duct Construction Standards, Metal and Flexible, Second Edition (1995)". The Manual shall be shop specific and submitted for review well in advance of sheet metal installation.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store ductwork and accessories inside, above grade, and enclose with waterproof wrapping.

1.4 DESIGN CRITERIA

- A. Low static pressure classifications shall be constructed to minimum 2" water gauge.
- B. Medium static pressure classifications shall be constructed to minimum 5" water gauge.
- C. Seal all sheet metal ducts, regardless of pressure class, to SMACNA Seal Class 'A'.
- D. Ceiling registers shall be designed for one, two, three, or four way blow to suit room conditions. The design documents shall indicate the flow directions.

- E. The design documents shall indicate the clear inside dimensions of lined or double wall ducts.
- F. The designer shall determine the type of sealant required for the project and include in the specifications.
- G. Part Two, 'KITCHEN EXHAUST SYSTEMS', lists three different types of kitchen exhaust systems. Refer to DC Standard 15010 for the requirements to determine the appropriate system for the project.
- H. With respect to rectangular ductwork, the ratio of duct height to duct width shall not exceed 2:1. In extraordinary conditions, this ratio may be extended to 2.5:1.
- I. The designer shall determine if duct testing is required.
- J. The designer shall determine if the ductwork is to be painted and if so, amend the specifications to include a finish on the sheet metal that will accept field painting.
- K. This standard assumes standard galvanized duct for air distribution systems. The designer is required to ascertain the suitability of this product for extraordinary applications, such as fume hoods, swimming pool ventilation, etc.
- L. Two types of control dampers are specified. For applications where dampers are exposed to outside air, and are normally closed 75% of the time or have a life safety requirement of not freezing in a position, use the insulated damper. For all other dampers use the non-insulated damper.
- M. All main electric rooms that are ventilated shall have filtered (30% efficiency) air.
- N. All return air shall be ducted, plenum return is not acceptable.

PART 2 PRODUCTS

2.1 DUCTWORK MATERIALS

- A. Galvanized sheet metal shall comply with ASTM A 924, lock forming quality, with G60 zinc coating for interior, dry duct and G90 zinc coating for exterior ducts and any ductwork susceptible to moisture, in accordance with ASTM A 653.

2.2 RECTANGULAR DUCT FABRICATION

- A. Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards, Second Edition (1995)" Tables 1-3 through 1-20, including associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals. Minimum duct gauge is 26.
- B. Cross break or bead duct sides that are 11" and larger and are 20 gauge or less, with more than 4 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-8, regardless if insulated.
- C. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard, Second Edition (1995)", Figures 2-1 through 2-9, with the following modifications:

1. Figure 2-2
 - a. Type RE1 – Square throat is not permitted.
 - b. Types RE4, 6, 7, 8, 9, & 10 are not permitted.
 2. Figure 2-3
 - a. Use single thickness vanes with 4-1/2" minimum trailing ends, SP=1-1/2".
 3. Figure 2-7
 - a. Offset types 1 & 2 are not allowed.
 - b. Minimum bell mouth radius shall be 1-1/2".
 4. Figure 2-8
 - a. Figures A & C are not allowed.
- D. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.
- E. Button punch snap lock (figure 1-5, type L-2) and internal standing seam joints (figure 1-6) are not allowed.

2.3 ROUND DUCT FABRICATION

- A. Except as otherwise indicated, fabricate round ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards, Second Edition (1995)" Tables 3-1 through 3-3 and figures 3-1 through 3-5. Conform to the requirements in the referenced standard for metal thickness and joint types. Modify the above tables and figures as follows:
1. Table 3-1
 - a. All elbows, regardless of duct velocity, shall be 1-1/2" radius to duct diameter.
 2. Figure 3-1
 - a. Seam types RL-3, 6A, 6B, 7, and * are not allowed.
 3. Figure 3-3
 - a. Adjustable elbows are not allowed.
 4. Figure 3-4
 - a. Non lateral taps may be used only where spatial conditions do not allow lateral taps.
 5. Figure 3-5
 - a. Replace the transition length formula listed ($L_2=A-B$) with the following: Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.
- B. Fittings shall be one gauge heavier than the duct size requirement, 22 gauge minimum.

2.4 HANGERS AND SUPPORTS

- A. Except as otherwise indicated, fabricate hangers and supports in accordance with SMACNA "HVAC Duct Construction Standards, Second Edition (1995)" Chapter Four. Modify the above chapter as follows:
1. Powder actuated fasteners are not allowed.
 2. Wire is not allowed to be used as a hanger support.

2.5 DOUBLE WALL DUCTWORK

- A. Construct double wall ductwork with a solid outer skin, gauge and reinforcement shall be as previously specified for single wall ductwork. Insulation shall be 1" thick duct liner. Inner skin shall be 26 gauge perforated galvanized steel.

2.6 DAMPERS

- A. Provide manual dampers of single blade type or multi blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards", Figures 2-12 and 2-13, amended as follows:
 - 1. Figure 2-12
 - a. Figure A is not allowed, use only figure B regardless of duct size.
 - b. Provide end bearings for all systems requiring Seal Class A regardless of pressure class.
- B. Provide galvanized steel control dampers with parallel blades for two position control, opposed blades for modulating control. Provide counterbalanced relief dampers with parallel blades, counterbalanced and factory set to relieve at indicated static pressure.
- C. Subject to compliance with requirements, provide dampers of one of the following:
 - 1. Air Balance, Inc.
 - 2. American Warming & Ventilating, Inc.
 - 3. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.
 - 4. Louvers & Dampers, Inc.
 - 5. Ruskin Mfg. Co.
 - 6. Vent Products Co., Inc
- D. Insulated dampers shall be constructed of aluminum with expanded polyurethane blades (R=2.2 min.) and a thermally broken, polystyrene filled frame. Blade & frame seals shall be extruded silicone. AMCA certified air leakage rate shall not exceed 4.1 cfm @ 4" wg (standard air). Dampers shall be manufactured to the actual opening, do not save off the opening to use stock sizes.
- E. Subject to compliance with requirements, provide dampers of one of the following:
 - 1. Tamco series 9000 BF.

2.7 FIRE DAMPERS

- A. Curtain type fire dampers constructed with casings of 20-22 galvanized steel with fusible link rated at $\pm 212^{\circ}\text{F}$. Test all dampers in accordance with UL555. Curtain must be completely out of the air stream when damper is open. All dampers must be dynamic rated for design class of the duct system and the air velocity. Rating of fire damper shall be compatible with the rating of the building structure (wall or ceiling) in which it is installed.
- B. Subject to compliance with requirements, provide dampers of one of the following:
 - 1. Air Balance, Inc.
 - 2. American Warming & Ventilating, Inc.
 - 3. Greenheck
 - 4. Prefco Products
 - 5. Ruskin Mfg. Co.

2.8 FLEXIBLE DUCTWORK

- A. Inner liner shall be a laminate of aluminum foil, fiberglass, and aluminized polyester reinforced with a mechanically attached galvanized steel helix; the outer facing shall be a polyethylene material; a 1" thick fiberglass insulation shall be factory installed between the liner and the outer facing. Operating pressure shall be 12" w.g positive, 10" w.g. negative on sizes ≤12"Ø, 12" w.g positive, 5" w.g. negative on sizes 14" & 16".
- B. Subject to compliance with requirements, provide dampers of one of the following:
 - 1. Buckley Associates – Flexmaster type 2
 - 2. ACCO

2.9 SHEET METAL ACCESSORIES

- A. Provide for each manually controlled damper, quadrant lock device on one end of shaft; and end bearing plate on other end. Provide extended quadrant locks and extended end bearing plates for externally insulated ductwork.
- B. Subject to compliance with requirements, provide dampers of one of the following:
 - 1. Duro Dyne National Corp.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Co.
- C. Construct duct access doors per the requirements of SMACNA HVAC Duct Construction Standards, Figures 2-10 & 2-11. Provide insulated doors for insulated ductwork. Provide one side hinged, other side with latching devices per the SMACNA schedule.

Access Door Schedule	
duct size (exposed width)	door size
<20"	2" less than duct size x 16"
>20"	18" x 18"

- D. Provide flexible duct connections resistant to mildew and ultraviolet rays wherever ductwork connects to vibration isolated equipment. Construct flexible connections, serviceable from -40°F to 250°F, of Durolon base, Hypalon coated flameproof fabric (24 ounces per square yard) crimped into duct flanges for attachment to duct and equipment. Make joint airtight.
- E. Non-hardening, non-migrating water based duct sealant mastic or liquid elastic sealant.
 - 1. Hardcast: Flex Grip
 - 2. United McGill: United Duct Sealer
- F. Two part duct sealant system consisting of an adhesive activator and fiber tape suitable for use outdoors.
 - 1. Hardcast: DT-5300 tape and RTA-50 adhesive
 - 2. United McGill: Uni-cast
- G. Duct Sealant specifically designed for use in flanged duct joints shall be continuous butyl rubber extrusion.
 - 1. Hardcast: Flange Grip #1902-FR

2.10 DUCT INSULATION

- A. Duct liner shall be ASTM C 1071, Type I, with coated surface exposed to air stream to prevent erosion of glass fibers. Surface shall be treated with an EPA registered anti-bacterial agent to prohibit the growth of fungus and bacteria. Duct facing shall be designed to resist damage from common dry duct cleaning processes as recommended by the North American Insulation Manufacturers Association (NAIMA) Duct Cleaning Guide. Provide sheet metal nosings for all duct velocities securely installed over transversely oriented liner edges facing the air stream. Thermal performance (1" thickness): "C-Factor" equal to 0.25 or better, "R-Factor" equal to 4.0 or better, at a mean temperature of 75° F. Minimum sound absorption ratings per the following schedule as tested using the ASTM C423 method:

Sound Absorption Coefficient @ Frequency (Cycles Per Second)							
Thickness	125	250	500	1000	2000	4000	NRC
1"	.09	.29	.67	.89	1.03	.99	.7
2	.16	.51	.9	1.05	1.06	1.01	.9

- B. Products: Provide products of the following manufacturers:
 - 1. Johns Manville: Permacote Linacoustic Standard
 - 2. Owens Corning: Aeroflex PLUS Duct Liner, type 300
 - 3. Knauf: Duct Liner E M, 2.0 pcf.
- C. Liner Adhesive: Comply with ASTM C 916.
 - 1. Hardcast: Glass Grip #GG-901
 - 2. United McGill: Uni-Grab Duct Liner Adhesive
 - 3. Duro Dyne: WIT
- D. Mechanical Fasteners: Galvanized steel welded to duct.
 - 1. DuroDyne: Spotter pins with PC metal washers.
- E. Flexible Fiberglass Duct Wrap: ASTM C553, Type 1, 0.75 PCF density, R value of 5.1 @ 1-1/2" thickness, 75° mean temperature, with silver FSK facing.
- F. Rigid Fiberglass Duct Wrap: ASTM C612, Type 1, 6.0 PCF density, R value of 6.6 @ 1-1/2" thickness, 75° mean temperature with silver FSK facing

2.11 REGISTERS, GRILLES, AND DIFFUSERS

- A. All R, G, & D's shall be factory finished white. Provide diffusers, registers and grilles with border styles that are compatible with adjacent wall and ceiling systems.
- B. Directional face ceiling supply diffuser shall have square face and neck, aluminum or steel with extension panel for installation in ceiling system. Diffusers in acoustical grid ceilings shall be mounted in lay-in panels. All diffusers shall have induction vanes.
 - 1. Krueger SHV Series
 - 2. Metalaire Series 5000, type IV
 - 3. Tuttle & Bailey Agitair RC Series
- C. Return and exhaust grilles shall be rectangular/square face, all aluminum construction with fixed angle (40°-45°) deflecting vanes.
 - 1. Krueger S580 Series
 - 2. Metalaire Series RH
 - 3. Tuttle & Bailey Series A 70D

- D. Double deflection sidewall return/exhaust grilles shall be extruded aluminum with front blades vertical. Provide with opposed blade damper with operator accessible through face.
 - 1. Krueger 5880 Series
 - 2. Metalaire Series V4004
 - 3. Tuttle & Bailey Series A60

2.12 LOUVERS

- A. Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners. Provide 1/2" square mesh anodized aluminum wire bird screens on inside face of exterior louvers.
 - 1. Air Balance
 - 2. Buckley Associates
 - 3. Construction Specialties, Inc.
 - 4. Louvers & Dampers, Inc.
 - 5. Ruskin Mfg. Co.

2.13 AIR TERMINALS (VAV BOXES)

- A. Casing shall be constructed of not less than 22 gauge galvanized steel with round collars and rectangular slip and drive discharge openings. Interior of unit casing shall be lined with not less than 1/2", 1-1/2 pcf fiberglass insulation. All exposed insulation edges shall be coated with an NFPA 90A approved sealant to prevent the entrainment of fibers into the airstream. Minimum box size is 6".
- B. Construct casings such that when subjected to 3" w.g. pressure, total leakage does not exceed four percent of specified air flow capacity or 10 cfm maximum with outlets sealed and inlets wide open. Construct air dampers such that when subjected to 5" w.g. inlet pressure with damper closed, total leakage does not exceed 2% of specified air flow capacity.
- C. Access doors shall be installed on all VAV boxes. Access doors shall be equipped with latches and hinges that are designed to be easily & repeatably opened. Access doors that are screwed to the box are not acceptable.
- D. Construct air dampers of materials that cannot corrode, do not require lubrication, nor periodic servicing. Linkage must be external to the box; internal linkage is not acceptable.
- E. Provide with multi-point, center-averaging flow sensor in inlet. Provide label on each unit indicating Plan Number, cfm range, cfm factory setting, and calibration curve. Provide hot water heating coils constructed of copper tubes and aluminum fins with galvanized steel casing.
 - 1. Anemostat
 - 2. Environmental Technologies
 - 3. Krueger
 - 4. Price
 - 5. Tuttle & Bailey

2.14 KITCHEN EXHAUST SYSTEMS

- A. System One: Installations conforming to the requirements of NFPA 96.
- B. System Two: Installations with deep stainless steel hoods with lock seams or welded seams (Vent A Hood model PWV18) with a single 300 cfm fan or remote fan. On both sides the hood shall extend 6" further than the range. Ductwork shall be galvanized steel conforming to the requirements of this Guideline.

- C. System Three: Installations using residential style, white hoods with self contained fans (Broan #4000; Nutone #SM6530WW). Hood width shall be the same as the range. Ductwork shall be galvanized steel conforming to the requirements of this Guideline.

PART 3 EXECUTION

3.1 GENERAL

- A. It is the responsibility of the sheet metal contractor to coordinate the work of his trade with all other trades prior to the commencement of construction. Any conflicts must be brought to the attention of the consultants or the owner.
- B. Open ends of ducts that are not actively being worked shall have a temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until connections are to be completed.
- C. Where duct testing is required, testing shall be performed per the SMACNA, "HVAC Air Duct Leakage Test Manual". All ducts, regardless of pressure class, shall conform to Seal Class 'A'.

3.2 METAL DUCTWORK

- A. Assemble and install ductwork in accordance with the applicable sections of SMACNA. Support vertical ducts at every floor. Where required, provide seismic hanger assemblies. Locate ductwork runs, except as otherwise indicated, vertically and horizontally avoiding diagonal runs wherever possible.
- B. Do not route ductwork through transformer vaults and electrical equipment spaces and enclosures.
- C. Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on all four sides by at least 1 1/2". Fasten flange to duct or substrate, not both.
- D. Prior to the installation of the sheet metal ducts, the sheet metal/mechanical contractor shall coordinate with the balancing contractor to insure volume dampers are located in locations where the balancing contractor can effectively perform his trade.
- E. Where applicable, do not adhere fabrication sheets to the interior of ductwork.

3.3 DUCT INSULATION & LINER

- A. Fabricate lined ductwork in accordance with the SMACNA 'Duct Construction Standards' and the NAIMA "Fibrous Glass Duct Liner Standard". Duct liner is allowed in return & exhaust (except kitchen, moisture laden, and rest room) systems only. Supply systems with duct liner shall be double walled or single wall with filters downstream of the liner. Secure the liner to the duct with minimum 95% coverage of adhesive and weld type pins. Provide metal nosings for transversely oriented liner edges facing the air stream.
- B. All exterior insulated duct shall be 1-1/2" thick. Use rigid board for all outside air plenums and ducts located in mechanical spaces, duct wrap for the balance of insulated duct. Insulate all supply air ductwork where temperature differences to the surrounding areas >10°F.

3.4 INSTALLATION OF FLEXIBLE DUCTS

- A. Install in accordance with Section III of SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible, Second Edition (1995)", maximum 6'-0" extended length. Install insulated type flexible ducts in all supply air ductwork with temperature differences to the surrounding areas >10°F, non-insulated or insulated type flexible ducts with temperature differences <10°F and in return air systems. Attach flexible duct to metal duct and end terminals with drawbands on both the inner sleeve and the outer jacket.
- B. Flexible ductwork shall be used to make corrections for minor misalignments of metal duct connections to diffusers. The angle of adjustment shall not exceed 30°. Flexible duct shall not be used to make sharp turns or any other configuration that compromises the net free area of the duct. Where flexible duct runs are perpendicular to the outlet of the diffuser, use either a full radius elbow or a diffuser box at the diffuser connection.

3.5 INSTALLATION OF DUCTWORK ACCESSORIES

- A. Install access doors to open against system air pressure. Install access doors at all fire dampers, smoke dampers, motor operated dampers, humidifiers, both sides of coils, and similar devices requiring access.
- B. Install manual balancing dampers in all locations required to balance the system.
- C. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators and/or equipment containing rotating machinery.
- D. Fire dampers shall be installed in strict accordance with the manufacturer's written and tested installation instructions that are shipped with each fire damper. Dampers shall be installed square and shall not be malformed due to stretching or compressing to fit in misfabricated sleeves.
- E. The 2000 International Mechanical Code requires smoke detectors be located in the air handler, NFPA 72 (2002) requires the smoke detector be located in the supply duct downstream of the air handler. As a point of clarification, the Town of Hanover wishes to comply with NFPA requirement rather than the IMC requirement.

3.6 REGISTERS, GRILLES, AND DIFFUSERS

- A. Provide sheet metal ceiling boxes when connecting ceiling diffusers with flexible ducts.

3.7 INSTALLATION OF AIR TERMINALS (VAV BOXES)

- A. Install air terminals level and with the manufacturer's recommended straight run of metal ductwork at inlet and outlet, flexible connectors may be installed on the outlet side of the box. Install so that damper operator, damper actuator, and hot water control valve actuator (where provided) can be readily serviced.

END OF SECTION 15890