

SECTION 15890: SHEET METAL WORK AND ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL:

1.1.1 Where any reference to "sheet metal" or "ductwork" appears in this section of these specifications or on the drawings, it shall be construed to include exhaust ducts, relief ducts, plenums, casings for air handling units, duct taps, grille taps and diffuser connections and all other related pieces and parts of the air conveying systems.

1.1.2 Before starting shop drawings or fabrication of any ductwork, the Contractor must have an approved reflected ceiling plan with which he can coordinate location of air outlets, lights, tile patterns, etc.

1.2 SCOPE:

Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the construction of complete Ductwork and Accessories System as indicated on the drawings, reasonably implied therefrom or as specified herein unless specifically excluded.

1.3 SHOP DRAWINGS:

Shop drawings shall be submitted on all items of sheet metal work only as specified hereinafter.

1.4 REFERENCED STANDARDS:

- ASHRAE - Guide and Data Books.
- SMACNA - HVAC Duct System Design, Second Edition 1981.
- NFPA - 90A, 90B, 91, 96, 204
- SMACNA - HVAC Duct Construction Standards, First Edition, 1985.

1.5 QUALITY ASSURANCE:

The contractor shall comply with this specification in its entirety. If on inspections, the specifier finds that changes have been made without written prior approval, the contractor shall make the applicable changes to comply with this specification, at the contractor's expense.

PART 2 - PRODUCTS

2.1 MATERIAL:

All sheet metal duct, plenum and casing construction, unless otherwise specified herein, shall be constructed of new, prime grade, continuous hot dip mill galvanized, lock forming quality steel sheets, per ASTM A653/A653M and A924/A924M, and shall have a galvanized coating of 1-1/4 ounces total for both sides of 1 sq. ft. of a sheet, in accordance W/G90 per ASTM A653/A653M and ASTM A924/A924M. Construction shall be in strict accordance with the construction details on plan and installation details in the referenced SMACNA and NFPA standards as specified. Referenced standards shall be used to define minimum construction requirements where more

stringent standards are not detailed on plans or specified herein.

2.2 LABELING AND GAUGE:

Each sheet shall be stenciled with manufacturer's name and gauge. If coil steel is used, coils shall be stenciled throughout on ten foot (10') centers with manufacturer's name and gauge. Sheet metal must conform to the tolerances listed in SMACNA HVAC Duct Construction Standards, First Edition, 1985. All duct systems penetrating 1 hour fire walls shall be of minimum 24 ga. construction.

2.3 LOW PRESSURE DUCTWORK CONSTRUCTION:

2.3.1 Construct low pressure ductwork to meet all functional criteria defined in NFPA 90A, NFPA 90B, and Section VII of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 1985 Edition. (This shall be subsequently referred to as the SMACNA manual.) All ductwork must comply with all local, state and federal code requirements.

2.3.2 Rectangular low pressure ducts shall be constructed and reinforced for 2"W.G. Longitudinal seams shall be Pittsburgh lock, sealed with mastic sealant. (Snaplock is not acceptable.)

Elbows shall be mitered with double thickness turning vanes or smooth radius long sweep elbows. Combination elbows (outside smooth radius with inside miter) are not acceptable.

2.3.3 Round low pressure ducts shall be constructed in accordance with Table 3-2 and 3-3 2" W.G. "Round Duct Gauge Selection" and Figure 3-2 "Transverse Joints-Round Duct" of SMACNA HVAC Duct Construction Standards, First Edition, 1985 and NFPA 90A and 90B.

Elbows shall be smooth elbows; 5 piece 90 degree elbows or 3 piece 45 degree elbows all with centerline radius 1-1/2 times the duct diameter.

2.3.4 <S> Low pressure flexible ducts shall be in accordance with SMACNA HVAC Duct Construction Standards, First Edition, 1985, NFPA 90A and 90B. Flexible duct shall be equal to Genflex Type IL-1, with couplings and end connections as required for proper installation and compatibility with ductwork system in which they are installed.

- A. All flexible ducts shall have positive interior air seal permanently bounded to a zinc coated high carbon spring steel helix all sheathed in a Class 1 vapor barrier factory sealed at both ends. The composite assembly including vapor barrier shall meet the Class 1 requirements of NFPA for use in a return air plenum, and be labeled by Underwriters Laboratories, Inc. 181 with a flame spread rating of 25 or less and a smoke developed rating of 50 or under.
- B. Low pressure flexible duct shall be rated to 1 1/2" w.g. working pressure.
- C. Flexible duct taps into low pressure plenums or main ducts shall be made with 45 degree side take-offs and rigid round duct with damper on a 3/8" square rod, nylon end bearings, graduated operators with stand-off brackets, and raised bead for tight, positive flex duct connection. Use insulation guard for internally lined ductwork. Duct connections and dampers shall be constructed of galvanized sheet metal, 24 gauge minimum for 12" diameter and smaller, 22 gauge minimum for 14" diameter, and 20 gauge minimum for

15" diameter. Damper assemblies shall be as manufactured by Greenheck or Ruskin.

- D. Flexible Duct Clamps: 100 percent nylon strap, 175 pounds minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class I installation.

2.3.5 <S> All exposed low pressure ductwork shall be factory lined, double wall spiral flat oval or spiral round as indicated on plans. Outer duct wall shall be paint-grip galvanized steel suitable for field painting unless noted otherwise.

2.4 MEDIUM PRESSURE DUCTWORK CONSTRUCTION:

All sheet metal ducts between the fan discharge and the air valves or mixing boxes shall be of medium pressure construction either of rectangular, spiral flat-oval or spiral round as indicated on the plans, in accordance with SMACNA HVAC Duct Construction Standards, First Edition, 1985 and NFPA 90A and 90B.

2.4.1 Construct rectangular medium pressure ductwork to meet all functional criteria defined in NFPA 90A, NFPA 90B and Section VII, of the SMACNA "HVAC Duct Construction Standards, Metal and Flexible" 1985 Edition. (This shall be subsequently referred to as the SMACNA manual. All ductwork must comply with all local, state and federal code requirements.

2.4.2 <S> Rectangular medium pressure ducts shall be constructed and reinforced for 6" W.G. Contractor shall submit with shop drawings a proposed gauge and reinforcement table for approval based on the above mentioned table. Longitudinal seams shall be Pittsburgh lock, sealed with mastic sealant. (Snaplock is not acceptable.)

Elbows shall be mitered with double thickness turning vanes or smooth radius long sweep elbows. Combination elbows (outside smooth radius with inside miter) are not acceptable.

2.4.3 <S> Spiral Flat-Oval medium pressure ducts shall be as manufactured by United Sheet Metal Company or equal with continuous weld fittings. Ducts shall be fabricated as spiral uniseal duct through 20" minor axis with longitudinal seam duct for minor axis of 22" or larger. Gauge shall be in accordance with SMACNA HVAC Duct Construction Standards, First Edition, 1985.

All 90 degree take-offs shall be made with conical tees. Take-off fittings shall be welded to fittings or to main duct and all welds shall be cleaned and coated with rust preventative paint.

2.4.4 <S> Spiral Round medium pressure ducts shall be as manufactured by United Sheet Metal or equal with continuous weld fittings with gauge as scheduled in table 3-2 and 3-3 10" W.G. "Round Duct Gauge Selection" of SMACNA HVAC Duct Construction Standards, First Edition, 1985.

2.4.5 <S> Flexible Duct used in the medium pressure portion of system shall be equal to Clecon, Flex 25, RF Series and shall have factory insulation, fittings, connectors, etc., as described herein before for low pressure flexible duct. NFPA approvals shall include the entire assembly, and shall also be as described herein before for low pressure flexible duct, and for return air plenum.

2.4.6 All exposed medium pressure ductwork shall be factory lined, double wall spiral flat oval or spiral round as indicated on plans. Out duct shall be paint-grip galvanized steel suitable for field painting unless noted otherwise.

2.5 JOINTS:

2.5.1 All joints shall be sealed airtight with water-based duct sealer equal to United duct sealer in a manner compatible with type joint being sealed. Sealer shall be installed per the instructions set forth in the SMACNA HVAC Duct Construction Standards, First Edition, 1985.

2.5.2 All sealed ducts shall be pressure tested at a developed and maintained system pressure. Leaks that whistle or are excessive shall be repaired and the test repeated. See Part 3 Execution.

2.5.3 As a Contractor option, transverse duct joints may be made with Ductmate System or approved equal with the following stipulation: "Ductmate or equal system may be employed only after Contractor personnel have been properly instructed by a manufacturer's representative in the application and installation of said system." Duct gauges shall be in strict accordance with Ductmate instructions.

2.5.4 Round Duct Joints: Round ductwork shall be spiral seam construction only. Gauges shall be in accordance with SMACNA Duct Construction Standard and fittings in accordance with SMACNA Duct Construction Standard, except as noted. Joints 0"-20" diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint diameter, use 3 piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal. Joints 73" diameter and up, use companion angle flanged joints only as defined on page 3-6 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Duct wall to be welded longitudinal seams.

2.5.5 Flat Oval Duct Joints: Flat Oval ducts shall be joined with the Ovalmate Connection System manufactured by Ductmate Industries. Consult the manufacturer for installation and construction guidelines. As an option, beaded sleeve joints may be used.

2.6 DUCT SUPPORTS:

2.6.1 All horizontal and vertical ducts shall be supported in accordance with SMACNA HVAC Duct Construction Standards, First Edition, 1985.

2.6.2 Flexible ducts shall be free of sags and kinks and supported on minimum of 36" centers with 3/4" wide flat banding material. Perforated strap will not be acceptable.

2.7 DUCT LINER:

2.7.1 All supply, return, and outside air ductwork as noted on the plans with dashed lines drawn inside the duct, and all ductwork exposed in mechanical rooms shall have integral lining in accordance with SMACNA HVAC Duct Construction Standards, First Edition, 1985, and NFPA 90A and 90B. Liner shall be 1-1/2 pound per cubic foot, 1" thick.

2.7.2 The ductwork serving the variable volume boxes and/or power terminal boxes shall be internally lined for distance of 10 lineal feet downstream of the box.

2.7.3 Where ducts are lined, exterior insulation will not be needed except as otherwise specified. Dimensions given on the drawings are inside the insulation, sheet metal sizes shall be increased to allow for the thickness of liner called for. Refer to Section 15010 for Flame Spread Properties.

2.7.4 Duct liner shall be equal to Manville "Linacoustic Permacote" meeting ASTM C1071; flexible blanket properly sealed at all joints and bare ends. Adhesive shall be UL listed water proof type. Fasteners shall be galvanized steel pins, welded or mechanically fastened.

2.7.5 Round duct liner shall be equal to Manville "Spiracoustic" meeting ASTM C427; Rigid.

2.8 DUCT ACCESS DOORS:

Duct access doors shall be hinged or Ductmate Sandwich Type Access Doors. (1" thick insulation bonded to interior face), 8" x 8" minimum size (duct opening) on ductwork up to 14" and 12" x 12" minimum size on larger ductwork. Doors shall be of adequate size to allow easy access to hardware/equipment that needs to be maintained.

2.9 AIR DISTRIBUTION DEVICES: <S>

2.9.1 Grilles, registers and ceiling outlets shall be as scheduled in the plans and shall be provided with sponge rubber or soft felt gaskets. If a manufacturer other than the one scheduled is used, the sizes shown on the drawings shall be checked for performance, noise level, face velocity, throw, pressure drop etc., before the submittal is made. Selections shall meet the manufacturer's own published data for the above performance criteria. The throw shall be such that the velocity at the end of the throw in the five foot occupancy zone will not be more than 50 FPM or less than 25 FPM. Should grilles other than those scheduled by name be furnished, manufacturer shall be prepared to demonstrate compliance with noise criteria on request to Architect's satisfaction. All devices shall be tested per Air Diffuser Council and labeled as such.

2.9.2 Locations of outlets on drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be governed by the established pattern of the lighting fixtures or Architectural reflected ceiling plan. Where called for on the schedules, the grilles, registers and ceiling outlets shall be provided with deflecting devices and manual dampers. These shall be the standard product of the manufacturer, subject to review by the Architect and equal to brand scheduled. All ceiling devices shall be furnished to be compatible with the type ceiling in which they are installed.

2.9.3 Air distribution devices shall be as manufactured by Titus, Metalaire, Krueger or Price only and shall be as scheduled on the drawings.

2.10 AIR HOODS: <S>

2.10.1 Hood (s) shall be constructed of aluminum rigidly supported to withstand wind forces "oil canning" and normal rough treatment during installation. Units shall be designed and installed to eliminate any standing water. The underside of the hood shall be coated with insulating mastic to prevent condensation.

2.10.2 Provide expanded aluminum mesh birdscreens and a matching 8" high aluminum curb with built-in 3" cant strip and a treated wood nailer installed as indicated on the drawings.

2.10.3 Relief, exhaust and smoke relief outlet hoods shall have a throat-to-hood outlet area ratio of 1 to 1.75 minimum.

2.10.4 Ventilation, outside and combustion air intake hoods shall have a throat-to-hood outlet area ratio of 1 to 1.75 minimum. Intake hoods shall be separated from exhaust outlets, flues, plumbing vent stacks, etc. a minimum 30 ft. for lab areas and minimum of 15 ft. for all other areas.

2.10.5 Acceptable manufacturers: Louvers and Dampers, Ruskin, Acme, Greenheck.

2.11 INSTRUMENT PORTS:

2.11.1 Instrument ports shall be a 2 5/8" diameter base, neoprene gasket 2" deep neck, screwed cover operated with No. 024 spanner wrench, mounting screws, equal to Young 1101.

2.12 FLUES: <S>

Provide double wall round type AL 294-c stainless steel vents, sizes as indicated. Vent caps shall be A.G.A. approved complete with collars, thimbles, storm collars, flashing jacks, etc., as required. Minimum clearances from combustible construction shall be in accordance with Standard Gas Code, Section 607. Vents shall terminate at least two (2) feet above the highest point where they pass through the roof of a building and at least two (2) feet higher than any portion of the building within 10 feet.

2.13 FIRE DAMPERS: <S>

2.13.1 Furnish and install UL labeled fire dampers with fusible links where indicated and/or required by local codes in accordance with NFPA 90A and 90B.

2.13.2 Fire dampers shall be 95% minimum free area Ruskin series IBD Classified UL-555.

2.13.3 Where dampers are installed in a horizontal position, provide stainless steel closure springs and cam type blade locks to insure complete damper shut-off.

2.13.4 Fire dampers shall be equipped with suitable frame style for round, oval or rectangular ducts.

2.13.5 Fire dampers shall only be installed in steel grilles, registers and diffusers. Aluminum air distribution devices may not be used in conjunction with fire dampers. It shall be the contractors responsibility to verify that only steel devices are used with fire dampers.

2.13.6 Acceptable manufacturers: Advanced Air, Ruskin, Air Balance, Airstream Products, Greenheck.

2.14 SMOKE DAMPER, OPERATOR AND DETECTOR: <S>

2.14.1 Provide opposed blade, motor operated type smoke damper and detector at each location sized as indicated on the drawings. Dampers shall be UL listed, factory assembled, constructed of galvanized steel in accordance with NFPA 90A, 90B, and UL5555. Smoke dampers shall be automatic reset type. (Provide remote control reset device).

2.14.2 Provide a two position, oil immersed, spring return type motor operator for each damper.

2.14.3 Provide a UL listed, chamber type obscuration principal duct mounted smoke detector mounted upstream of the damper to operate the motor operator. Unit shall operate at 120AC.

2.14.4 Acceptable manufacturers

Smoke Dampers: Ruskin, Airstream, Products, Louvers & Dampers
Motor Operators: Barber Coleman MA-418-120V, Honeywell
Smoke Detector: Simplex 4259-52 (120V), Edwards, Pyralarm, Ferriday

2.15 COMBINATION FIRE AND SMOKE DAMPERS: <S>

2.15.1 Provide opposed blade, motor operated type combination fire and smoke damper for each location, sized as indicated on the drawings. Dampers shall be UL listed, per UL-555 and UL-555S, factory assembled, constructed of galvanized steel in accordance with NFPA 90A and 90B. Provide remote reset device.

2.15.2 Provide a two position, oil immersed, spring return type motor operator for each damper.

2.15.3 Provide a UL listed, chamber type obscuration principal duct mounted smoke detector mounted upstream of the damper to operate the motor operator. Unit shall be 120 AC.

Smoke Dampers: Advanced Air, Ruskin, Airstream, Products, Louvers & Dampers
Motor Operators: Barber Coleman MA-418-120V, Honeywell
Smoke Detector: Simplex 4259-52 (120V), Edwards, Pyralarm, Ferriday

2.16 STAINLESS STEEL DUCTWORK: <S>

Stainless steel used to fabricate Stainless Steel Ductwork Systems shall be 16 GA. type 316L, stainless steel finish 2B (dull).

Under paragraph 2.16, stainless steel ductwork shall be Type 304 stainless steel, welded. Note that laboratory exhaust ductwork system shall be stainless steel. [Add6-11]

PART 3 - EXECUTION

3.1 WORKMANSHIP, QUALITY AND REQUIREMENTS:

3.1.1 Ductwork shown on the drawings, specified or required for the heating, ventilating and air conditioning systems shall be constructed and erected in a first class workmanlike manner in accordance with SMACNA recommendations for low pressure and medium pressure duct construction unless more stringent requirements are specified herein. This work shall be warranted for a period of

one year from the date of acceptance of the job against noise, chatter, whistling or vibrations and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall either be removed and replaced or reinforced as directed by the Architect.

3.1.2 Ductwork shall be erected in the general locations shown on the drawings, but must conform to all structural and finish conditions of the building. Before fabricating any ductwork, the Contractor shall check the physical conditions at the job site and shall make all necessary changes in cross sections, offsets, etc., whether they are specifically indicated or not.

3.1.3 Provide manually operated volume control dampers in all branches, splits and taps for proper balancing of air distribution whether indicated on the drawings or not. Dampers to be either single blade or multi-blade as shown in the SMACNA manual as required and as detailed on plans. They shall have an indicating device with lock to hold damper in position for proper setting.

3.1.4 Damper operators above inaccessible ceilings shall be furnished with extension rods operable through diffuser and grille faces or from remote locations.

3.1.5 All square elbows shall have double thickness turning vanes per the SMACNA manual requirements except for any return air jumper ducts noted on drawings.

3.1.6 Furnish and install in the ductwork, hinged or Ductmate Sandwich type access doors to provide access to all dampers, automatic dampers, fusible links, cleaning operations, etc. Where the ducts are insulated, the access doors shall be double skin doors with one inch (1") of insulation in the door. Factory fabricated doors as manufactured by Ductmate, Milcor or equal meeting these specifications will be acceptable.

3.1.7 Where ducts connect to mechanical equipment with fans, including roof exhausters, flexible connections shall be made using "Ventglas" fabric that is fire-resistant, waterproof, mildew-resistant and practically air tight and shall weigh approximately thirty ounces (30 oz.) per square yard. There shall be a minimum of one-half inch (1/2") slack in the connections and a minimum of two and one half inches (2 1/2") distance between the edges of the duct except that there shall also be a minimum of one inch (1") of slack for each inch of static pressure on the fan system.

3.1.8 Furnish and install screens on all ducts, fans, etc., and openings furnished by this Contractor which lead to, or are, outdoors. Screens shall be 16 gauge, one half inch (1/2") mesh in removable galvanized steel frames.

3.1.9 Furnish test openings with covers in each zone duct for taking readings of air velocities or pressures in ducts. See the SMACNA manual for cover construction.

3.1.10 All holes in ducts for damper rods and other necessary devices, shall be either drilled or machine punched, (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for any length of time. In general, sheet metal screws shall not be used in duct construction unless the head (not the point) of the screw is in the airstream. Transformations shall have a ratio of not more than one inch (1") in transformation to every two inches (2") of length unless specifically shown otherwise on the drawings.

3.1.11 All duct drops to return and exhaust grilles shall be full size of the grille, and internally lined with 1" thick duct liner (except in healthcare facilities). The inside of all grilles, branch ductwork and duct drops shall be "blacked-out" with a minimum of two (2) coats flat black paint.

3.1.12 Ductwork Leakage Criteria:

- A. All transverse joints and longitudinal seams shall conform to SMACNA's Class A sealing requirements as defined on pages 1-6 of the 1985 SMACNA Manual, First Edition.
- B. Constant Volume Systems/Supply Ductwork
Allowable Leakage-----1% of design cfm.
- C. Constant Volume Systems/Return Ductwork
Allowable Leakage-----2% of design cfm.
- D. Variable Air Volume Systems/Supply Ductwork
Fan to VAV Boxes-----1% of design cfm.
VAV Boxes to Registers-----2% of design cfm.
- E. Variable Air Volume Systems/Return Ductwork
Allowable Leakage-----2% of design cfm.

3.1.13 Leakage Testing of Installed System:

- A. The installed new duct systems shall be tested to the designed operating pressure.
- B. The air leakage at the test pressure shall be measured by a calibrated orifice type of flow meter. Total allowable leakage of the system shall not exceed the percentage of design cfm outlined above.
- C. Leakage concentrated at one point may result in objectionable noise even if the system passes the leakage rate criteria. This noise source must be corrected to the satisfaction of the engineer.
- D. All leak testing shall be witnessed by the engineer or representative of the engineer. The contractor shall give the engineer 72 hours notice prior to testing. Any testing not witnessed by the engineer or his/her representative, shall be considered invalid and will be redone.
- E. The testing shall be performed as follows:
 - 1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
 - 2. Use a certified orifice tube for measuring the leakage.
 - 3. Define section of system to be tested and blank off.
 - 4. Determine the percentage of the system being tested.
 - 5. Using that percentage, determine the allowable leakage (cfm) for that section being tested.
 - 6. Pressurize to operating pressure and repair any significant or audible leaks.
 - 7. Re-pressurize and measure leakage.
 - 8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

3.2 DUCT LINER:

- A. Adhere insulation to sheet metal with full coverage of a UL listed adhesive.
- B. Secure insulation with mechanical liner fasteners as indicated by SMACNA or manufacturer. Pin length should be as recommended by the liner manufacturer.
- C. All exposed edges of the liner must be factory or field coated with mastic. For systems operating at 4000 fpm or higher a metal nosing must be installed over all liner leading edges in addition to the mastic coating.
- D. Repair liner surface penetrations with UL listed adhesive.
- E. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 FLASHING:

3.3.1 Where ducts pass through roofs or exterior walls, suitable flashing shall be provided to prevent rain or air current from entering the building. The flashing shall be not less than No. 24 gauge galvanized steel.

3.3.2 Where ducts exposed to view pass through walls, floors or ceilings, furnish and install sheet metal collars to cover the voids around the duct.

3.4 FIRE DAMPERS:

3.4.1 Fire dampers shall be installed in accordance with the SMACNA recommendations and as detailed on the drawings.

3.4.2 Provide a duct access panel for each fire damper.

3.4.3 Seal wall and floor penetrations with approved firestopping material. Firestop shall be equal to BIO Fireshield, Inc., BIO K-2.

3.5 COMBINATION FIRE AND SMOKE DAMPERS:

3.5.1 Smoke dampers shall be installed in accordance with manufacturer's and SMACNA recommendations. Coordinate wiring requirements with electrical contractor.

3.5.2 Provide a duct access panel for each smoke detector.

3.6 SMOKE DAMPERS:

3.6.1 Smoke dampers shall be installed in accordance with the manufacturer's and SMACNA recommendations. Coordinate wiring requirements with electrical contractor.

3.6.2 Provide a duct access panel for each smoke damper.

3.7 STAINLESS STEEL DUCTWORK SYSTEM:

3.7.1 Provide a stainless steel ductwork system routed and sized as indicated complete with accessories as indicated. System shall be fabricated of type 316L stainless with continuously welded joints.

3.7.2 Straight duct shall be round or rectangular as by SMACNA.

3.7.3 Permanent joints shall be made by neat continuous welded bead using type 316L welding rod and belled joints. Buttweld joints are not acceptable.

3.7.4 Serviceable joints at the hood and fan connections shall be made with means of a stainless steel draw band operated by a worm gear or off-center buckle. Provide 60 durometer neoprene gasket for serviceable joints.

3.7.5 Install all ductwork sloping towards exhaust hoods.

3.7.6 SMACNA manual shall be followed insofar as supports, configurations of fittings, etc.

3.8 MEDIUM PRESSURE DUCTWORK:

3.8.1 All rectangular duct joints shall be installed using a flanged connector between joints equal to Ductmate. All flanges shall be installed and sealed per the manufacturer's recommendations.

3.8.2 All round duct joints shall be installed using a male coupling to connect the two pieces of pipe and shall be installed and sealed per the manufacturer's recommendations. Sealant may be either a mastic sealer or hard cast.

3.8.3 All flat oval duct joints shall be installed using a male coupling to connect the two pieces of pipe and shall be installed per the manufacturer's instructions. Sealant may be either a mastic sealer or hard cast.

3.8.4 Provide external reinforcement depending upon duct size and pressure as recommended by the manufacturer or the latest SMACNA standards whichever is more stringent.

END OF SECTION