PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Turning vanes.

B. Backdraft dampers.

C. Combination fire and smoke dampers.

D. Duct access doors.

E. Duct hardware.

F. Fire dampers.

G. Flexible duct connectors.

H. Volume control dampers.

I. Duct opening closure film.

J. Cable operated damper systems.

K. Fire rated duct wrap.

L. Flexible ductwork.

M. Flexible elbow assembly.

1.02 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.

B. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. ASTM E477 - Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

E. ASTM E814 - Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops.

F. ASTM E 2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

G. ISO 6944 - Fire Containment — Elements of Building Construction.

H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

I. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

J. NFPA 92 - Standard for Smoke Control Systems.

K. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

M. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

N. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

O. UL 181 - Factory-Made Air Ducts and Connections.

P. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

Q. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

R. UL 555C - Standard for Safety Ceiling Dampers.

S. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

T. UL 1479 - Fire Tests of Through-Penetration Firestops.

U. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.

V. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revision

1.03 SUBMITTALS

A. Product Data: Provide for each type of ductwork accessory the following:

1. Electrical characteristics.
2. Connection requirements.

3. Dimensions.
4. Capacities
5. Materials of construction.

B. Shop Drawings: Indicate for shop fabricated assemblies the following:

1. Interfacing requirements with ductwork.
2. Method of fastening or support.
3. Methods of assembly of components.

C. Performance Data: Submit performance data for duct silencers including insertion loss performance in octave bands from 63 Hz to 8,000 Hz and pressure drop at specified airflow.

D. Project Record Drawings: Record actual locations of access doors and test holes.

E. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. SMACNA Compliance: Comply with applicable portions of SMACNA (DCS).

C. UL Compliance:

1. Fire Dampers: Construct, test, and label fire dampers in accordance with current edition of UL Standard 555.
2. Smoke Dampers: Construct, test, and label smoke dampers in accordance with current edition of UL Standard 555S.
3. Flexible Ductwork: Construct flexible ductwork in compliance with UL Standard 181.
4. Duct Tape: Label in accordance with UL Standard 181B and marked 181B-FX.
5. Duct Clamps: Label in accordance with UL Standard 181B and marked 181B-C.
6. Fire Rated Duct Wrap: Meet the fire protection requirements defined by UL Standard 1479.
7. Grease Exhaust Duct Wrap: Meet the fire protection requirements defined by UL Standard 1479.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated

E. NFPA Compliance:

1. Comply with applicable provisions of NFPA 90A and NFPA 90Bpertaining to installation of ductwork accessories.
2. Comply with NFPA 96 for fire-rated grease exhaust ducts.

F. ASTM Compliance: Products shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 "Surface Burning Characteristics" (NFPA 255) method.

1. Grease exhaust duct wrap shall be tested for performance in accordance with ASTM E 2336 "Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems" and ASTM E814 "Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops".
2. Fire rated duct wrap shall be tested in accordance with ASTM E814 "Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops".

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect ductwork accessories during shipping and storage from dirt, debris and moisture damage.

B. Protect dampers from damage to operating linkages and blades.

1.06 SPARE PARTS

A. Extra Fusible Links: One link for every 10 installed of each type, size and temperature range. Obtain receipt.

PART 2 - PRODUCTS

2.01 TURNING VANES

A. Manufacturer:

1. Aero Dyne Co.
2. Anemostat Products Div.; Dynamics Corp. of America.
3. Ductmate Industries.
4. Duro Dyne Corp.
5. Elgen Manufacturing Co., Inc.
6. Hart & Cooley Mfg. Co.
7. Register & Grille Mfg. Co., Inc
8. Sheet Metal Connectors, Inc.

B. Manufactured Turning Vanes: Provide turning vanes and runners fabricated from galvanized sheet metal, lock-forming quality, ASTM A 653, minimum Coating Designation G 60, of the same gauge thickness or greater as the ductwork in which they are installed.

1. Vanes shall be rigidly fastened with guide strips to minimize noise and vibration.
2. Vanes in ductwork over 30" deep shall be installed in multiple sections with vanes not over 30" long and shall be rigidly fastened.
3. Turning vanes shall be constructed per SMACNA Duct Construction Standards Metal and Flexible – 2005 Edition, Figure 4-3 and set into side strips suitable for mounting in ductwork.

C. Acoustical Turning Vanes: Provide acoustical turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill in systems serving noise critical spaces. Refer to Section "Common Work Results for HVAC" for noise critical spaces.

2.02 BACKDRAFT DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Arrow United Industries.
3. Cesco
4. Greenheck
5. Louvers & Dampers, Inc.
6. Nailor Industries, Inc.
7. Pottorff
8. Ruskin Mfg. Co.
9. TAMCO
10. Vent Products

B. Backdraft Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to open at indicated static pressure. Provide adjustment device to permit setting for varying differential static pressure

1. Construct frames of minimum16 gauge galvanized steel or 10 gauge aluminum.
2. Construct blades of minimum 16 gauge aluminum.
3. Provide minimum 1/2" diameter, corrosion-resistant bearings and 1/2" diameter, galvanized or stainless steel axles.
4. Mechanically lock blade edge seals into blade edge. Provide neoprene seals for round dampers and silicone or vinyl seals for rectangular dampers.

2.03 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Cesco Products.
3. Greenheck
4. Louvers & Dampers, Inc.
5. Nailor Industries, Inc.

6. Pottorff
7. Prefco Products, Inc.
8. Ruskin Mfg. Co.

B. General: Provide combination fire and smoke dampers at locations indicated on the drawings. Damper ratings shall be as required to maintain the fire and/or smoke ratings noted on the architectural drawings. Provide duct access door for inspection and service to each fire and smoke damper and fusible link as required. Provide sleeves of length as required to meet the installed location. Damper assemblies shall be provided as a single unit from the manufacturer.

C. Fabricate dampers in accordance with NFPA 90A, UL555 (current edition) classified fire damper of rating required for location installed, UL555S (current edition) classified smoke damper for leakage class II and rated for dual directional airflow.

D. Fire/smoke dampers shall be rated for closure in ducts up to minimum velocity of 2,000 fpm and static pressure of 4" w.g.

E. Multiple Blade Dampers:

1. Frame: Minimum 16-ga galvanized steel. Construct casings of 16 gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings.
2. Blades: Minimum 22 gauge thickness with airfoil or longitudinal grooved shape for airflow velocities up to 2,000 fpm and airfoil shape for airflow velocities greater than 2,000 fpm.
3. Bearings: Self-lubricating, turning in extruded hole in the frame.
4. Linkage: Plated steel axles, linkage concealed in frame, 1/2" actuator shaft.
5. Seals: Flexible, stainless steel jamb seals, silicone rubber blade seals with galvanized steel mechanical locked in to the blade edge and stainless steel spring loaded leakage seals in sides of casing. Provide stainless steel spring loaded leakage seals in sides of casing, and the following additional features:

    a) Open-closed indication switch.

F. Operators:

1. UL listed and labeled.
2. Spring return open/fail closed operation.
3. Two-position or modulating as required for the installation.
4. Electric type suitable for 120 Volts, single phase, 60 Hz.
5. Factory installed on dampers.
6. All operators shall open in between 7 and 15 seconds and close in between 7 and 15 seconds after alarm or smoke detection has occurred.
7. Rated for a minimum of 20,000 cycles of operation.
8. Provide automatic reset of damper upon cessation of detector (test or actual smoke detection), and normalization of duct air temperature.

G. Electro Thermal Link: Provide resettable temperature device rated at 160 to 165 degrees F (71 to 74 degrees C) unless otherwise indicated.

H. Smoke Activation:

1. Provide terminal block for connection to the building fire alarm system.

I. Accessories:

a) Open-closed indication switch.

2.04 DUCT ACCESS DOORS

A. Manufacturers:

1. Air Balance Inc.
2. Ductmate Industries.
3. Duro Dyne Corp.
4. Greenheck.
5. Register & Grille Mfg. Co., Inc.
6. Ruskin Mfg. Co.
7. Ventifabrics, Inc.
8. Vent Products.
9. Zurn Industries, Inc.; Air Systems Div.

B. Provide, where indicated on the drawings or where specified in Part 3 of this section, duct access doors of size allowable by duct dimensions with, unless otherwise noted on the drawings, minimum size of 10” by 10” and maximum size of 24” by 24”. Fabricate in accordance with SMACNA (DCS) and as indicated. Label access doors for fire and smoke dampers as specified in Part 3.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. Construct of same or greater gauge as ductwork served. For insulated ductwork. install minimum 1 inch thick insulation with sheet metal cover. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct.

1. 12 inches square or less: Provide one size hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Provide removable section of duct where duct size is too small for a 10” by 10” access door.
2. Larger than 12 inches square: Provide two hinges and two handle-type latches.

2.05 DUCT HARDWARE

A. Manufacturers:

1. Ductmate Industries.
2. Elgen Manufacturing Co., Inc.

3. Ventfabrics, Inc.
4. Young Regulator Co.

B. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated.

1. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
2. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

C. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.06 FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Cesco Products.
3. Greenheck
4. Louvers & Dampers, Inc.
5. Nailor Industries, Inc.
6. Pottorff
7. Prefco Products, Inc.
8. Ruskin Mfg. Co.

B. General: Provide fire dampers at locations indicated on the drawings. Damper ratings shall be as required to maintain the fire ratings noted on the architectural drawings. Provide duct access door for inspection and service to each fire damper and fusible link as required. Provide sleeves of length as required to meet the installed location.

C. Fabricate in accordance with NFPA 90A and UL 555 and as indicated.

D. Fire dampers shall be dynamic-rated for closure under pressure.

E. Provide positive lock in closed position.

F. Ceiling Radiation Dampers

1. General: Conform to UL 555C or tested in accordance with UL 263.
2. Casing: Galvanized steel frame in gauges as required to maintain applicable UL classification.
3. Damper Blades: Galvanized steel with UL classified thermal insulation as required to meet UL criteria and fire and smoke ratings noted on the architectural drawings.
4. Fusible link: Integral to device, rated at 165 degrees F.

5. Accessories: Provide as required for the installation:

a) Volume Controller: Manually adjustable volume controller integral to the assembly used to regulate airflow through the damper for testing and balancing.
b) Boot Fitting: Factory provided elbow, end or straight type. Include field provided collar, flanged recess, or ceramic thermal blanket.
c) Box Fitting: Factory provided 26 gauge with field provided collar, flanged recess, or ceramic thermal blanket.

G. Horizontal Dampers: Minimum 22 gauge galvanized steel frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket. Construct casings of 20 gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings.

H. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream. Construct frames of 20-gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings.

I. Multiple Blade Dampers: Minimum 16 gauge, galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock. Construct frames of 20-gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings

J. Fusible links: UL 33 rated at 160 to 165 degrees F unless otherwise indicated.

K. Accessories:.

2.07 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:

1. Carlisle HVAC Products.
2. Ductmate Industries.
3. Duro Dyne Corp.
4. Elgen Manufacturing Co., Inc.
5. Ventfabrics, Inc.

B. Fabricate in accordance with SMACNA (DCS) and as indicated. Flexible connectors shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

C. Flexible Duct Connections: Fabric crimped into metal edging strip. Provide metal compatible with connected ducts. Factory fabricated. Flame-retardant or noncombustible fabrics compliant with NFPA 701.

1. Indoor Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric compliant with NFPA 90A.

   a) Minimum Weight: 26 oz./sq. yd.
   b) Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   c) Service Temperature: Minus 40 to plus 200 deg F.

2. Metal: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of minimum 24 gauge galvanized sheet steel or 0.032-inch- thick aluminum.

D. Maximum Installed Length: 14 inch.

E. Coatings and Adhesives: Comply with UL 181, Class 1.

2.08 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Arrow United Industries
3. Cesco
4. Greenheck
5. Louvers & Dampers, Inc.
6. Nailor Industries, Inc.
7. Pottorff
8. Rossi Air Flow
9. Ruskin Mfg. Co.
10. TAMCO
11. Vent Products

B. Fabricate dampers in accordance with SMACNA (DCS) and as indicated. Construct using galvanized steel for standard air systems, aluminum for wet or natatorium environments and stainless steel for corrosive environments.

C. Single Blade Dampers:

1. Fabricate for duct sizes up to 12 x 36 inch.
2. Blade: 20 gauge, 0.04 inch, minimum.

D. Multi-Blade Damper: Fabricate of parallel or opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

1. Blade: 18 gauge, 0.0478 inch, minimum.

E. Bearings: Corrosion resistant, molded synthetic.

F. Axles: Positively lock into the damper blade.

G. Blade Seals: Where used for shutoff duty, provide Neoprene seals for round dampers and silicone for rectangular dampers.

H. Quadrants:.

1. Provide locking, indicating quadrant regulators.
2. On insulated ducts, provide extended shafts and mount regulator on standoff bracket, base or adapter.
3. Where rod lengths exceed 48 inches, provide regulator at both ends.

2.09 DUCT OPENING CLOSURE FILM

A. Mold-resistant, self-adhesive film to keep debris out of ducts during construction.

B. Thickness: 2 mils.

C. High tack water-based adhesive.

D. UV stable.

E. Elongation Before Break: 325 percent, minimum.

2.010 CABLE OPERATED DAMPER SYSTEMS

A. Manufacturer:

1. DuroDyne, DuroZone.
2. Metropolitan Air Technology, Inc. (Reference model number for round damper is RT-250 and for rectangular damper is RT-200).
3. Young Regulator Co. (Reference model number is 270).

B. General: Where access to dampers through a hard ceiling is required, provide a concealed, remote cable-operated, butterfly-type volume damper assembly with external worm gear operator.

C. Damper assembly shall include duct casing with rolled bead stiffeners, reinforced blade, self-lubricating bearing, and remote operator mounting plate.

D. Adjustable through the diffuser frame with standard 1/4 inch nut-driver or flat screwdriver.

E. Cable assembly shall attach to damper as a single piece with no linkage adjustment required.

F. Positive, direct, two-way damper control with no sleeves, springs or screw adjustments to come loose after installation.

G. Cable length as required to span the distance from the damper to the remote operator location.

H. Where approved by Architect, a ceiling cup with cover plate can be used for access to cable operator.

2.011 FIRE RATED DUCT WRAP

A. Manufacturers:

1. 3M.
2. Pyroscat
3. Thermal Ceramics
4. Unifrax Corporation

B. Grease Exhaust Ducts:

1. Reference manufacturer and model number is Unifrax FyreWrap Elite 1.5.
2. Minimum two-hour rated duct wrap insulation for Type I hood grease exhaust duct applications.
3. Two layers of 1-1/2 inch thick.
4. Density: Minimum 6 lb. per cubic foot.
5. Zero clearance to combustibles.
6. Flexible wrap enclosure rated for minimum 2000 F.
7. Material: Non-mineral wool, passive, low biopersistant fiber totally encapsulated with aluminum foil reinforced with scrim. UL Listed in accordance with ASTM E2336.
8. Attachments:
    a) Ducts smaller than 24” by 24” in size, provide stainless steel bands at insulation seams and on maximum 12 inch centers to hold the outer layer of the blanket enclosure in place.
    b) Ducts larger than 24” by 24” in size, provide pins to hold the outer layer in place.
9. Insulation shall be tested for intended use in accordance with all applicable codes and shall be approved by the local code official.
10. Provide factory-built access doors by same manufacturer as fabricated for use specifically with the insulation system.

C. General for HVAC Ducts:

1. Reference Manufacturer and Model Number is Unifrax FyreWrap Elite 1.5.
2. Provide duct wrap insulation for HVAC ducts required to be in rated enclosure construction where dampers are restricted.
3. One, two or three hour-rating as required for the installation.
4. 1-1/2 inch thick wrap.
5. Density: Minimum 6 lb. per cubic foot.
6. Zero clearance to combustibles.
7. Flexible wrap enclosure rated for minimum 2000 F.
8. Applied in one or more layers to achieve the hourly rating requirement.
9. Material: Non-mineral wool, passive, low biopersistant fiber totally encapsulated on all sides with aluminum foil reinforced with scrim. UL

Listed in accordance with ISO 6944 and UL 1479, and as acceptable to the Authority Having Jurisdiction.

D. Access Doors:

1. Manufacturer and/or model number:

a) Ductmate Ultimate.
b) FlameGard.
c) Thermal Ceramics FastDoor XL.
d) Equivalent.

2. Duct access door to be tested and listed in accordance with UL1978.
3. Gaskets: Liquid tight and minimum 1500F rated.
4. Duct access to be provided with 2-hour and zero clearance insulation cover tested and UL Listed per ASTM E2336 by same manufacturer and as fabricated for use specifically with the insulation system.

2.012 FLEXIBLE DUCTWORK

A. Manufacturers:

1. ATCO Rubber Products.
2. Flexmaster.
3. JPL (J.P. Lamborn Co)
4. Thermaflex.

B. Construction: Provide flexible ductwork conforming to UL 181-Class I, NFPA 90A and NFPA 90B and as follows. Duct types of manufacturers are indicated for reference in regard to required quality of construction and materials.

C. Insulated Flexible Ductwork: Provide duct fabric of ply-vinyl film, polyethylene film or multiple layers of aluminum laminate supported by helically wound spring steel wire. Wrap fabric with fiberglass insulation and provide fire retardant polyethylene or reinforced metalized protective vapor barrier as specified herein.

1. Duct pressure class up to and including 6” w.g.

a) Fire retardant polyethylene vapor barrier

1) ATCO 80 Series
2) Flexmaster Type 5B
3) JPL Type PR Series
4) Thermaflex Type G-KM

b) Reinforced metalized vapor barrier

1) ATCO 30 Series
2) Flexmaster Type 5M
3) JPL Type MHP Series
4) Thermaflex Type M-KE

2. Flexible ductwork shall have CPE liner with steel wire helix mechanically locked or permanently bonded to the liner.
3. Provide acoustical, fiberglass insulated duct with minimum R-value of R-6.0.

2.013 FLEXIBLE ELBOW ASSEMBLY

A. Manufacturers:

1. Build Right Products, FlexRight Elbow.
2. Flexible Technologies, Inc,, FlexFlow Elbow.
3. Titus, FlexRight.

B. General: At Contractors option, in lieu of rigid sheet metal elbows at connections to air inlets and outlets in concealed spaces, provide flexible elbow assembly to air devices requiring a 90 degree elbow connection.

C. Flexible elbow assembly shall be constructed of durable composite material and UL listed for use in return air plenums with a turning radius of not less than 3 inches.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Provide turning vanes, of same gauge as ductwork, rigidly fastened with guide strips in ductwork having an offset of 45 degrees or more. Provide vanes in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease or dryer exhaust ductwork.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Provide combination fire and smoke dampers, fire dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction.

1. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
2. Coordinate all smoke and fire/smoke damper installation, wiring, and checkout to ensure that the dampers function properly and that they respond to the proper fire alarm system signal.
3. Install ceiling radiation dampers per manufacturer's instructions. Support damper assembly from structure.
4. Demonstrate re-setting of fire and fire/smoke dampers to Owner's representative.

E. Provide duct access doors to maintain and/or clean components internal to ductwork including, but not limited to, coils, airflow stations, motorized and backdraft dampers, humidifiers, etc, Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

1. Provide duct access door(s) as scheduled below, at each fire and smoke damper within 12 inches of the device to allow for testing and maintenance. Label each door (with minimum 1" lettering) indicating which damper type is served. Door shall be capable of being fully opened or provide removable door.

DUCT ACCESS DOOR SCHEDULE

Duct Width/Depth	Door Size	Quantity
10" TO 12"	10 X 10	1
14" TO 18"	12 X 12	1
20" TO 36"	14 X 14	1
38" TO 54"	18 X 18	1
56" TO 72"	18 X 18	2 (1 EACH END)
74" TO 96"	20 X 20	2 (1 EACH END)

2. Provide duct access doors for cleaning kitchen exhaust ducts in accordance with NFPA 96. Review locations prior to fabrication.

F. Provide flexible duct connections wherever ductwork connects to vibrating equipment and when transitioning between two different metallic duct materials (e.g., aluminum to galvanized steel). Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

1. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
2. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

G. Provide volume control dampers at branch takeoffs from main ducts. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual volume control damper and locking quadrant for branch duct connections and take-offs to individual diffusers, registers and grilles.

H. Provide cable operated volume dampers with remote operators where access to dampers through a hard ceiling is required.

1. Support cable assembly to avoid bends and kinks in cable.

I. Install grease exhaust and fire rated duct wrap in accordance with manufacturer's instructions to provide the fire rating of the material as tested per UL requirements. Joints at insulation seams, banding, pins, and fire stop systems shall be installed as per manufacturers UL Listing and manufacturers published installation instructions. Overlap seams, install stainless steel bands and/or pins to secure wrap to duct and fill annular spaces in floor and wall penetrations with UL rated forming materials and/or putty to maintain the integrity of the system.

J. Install flexible ductwork in accordance with manufacturer's instructions. At a minimum, install two wraps of duct tape around the inner core connection and a metallic or non-metallic clamp over the tape and two wraps of duct tape or a clamp over the outer jacket.

1. Flexible ductwork runs shall not exceed 5 feet in length. Utilize the minimum length of duct to make the connections.
2. Install flexible ductwork straight as possible avoiding tight turns with a maximum of one 90 degree bend in any length. Install flexible ductwork fully extended minimizing compression.
3. Provide continuous length with no intermediate joints.
4. Support flexible ductwork from structure and not from ceiling tile, light fixtures or air terminals. Support for maximum sag of 1/2-inch per foot.
5. Avoid incidental contact with metal fixtures, water lines, pipes, or conduit.
6. Support straps/saddles shall be minimum 1-1/4" wide. Use of wire hanging systems shall utilize strap and connect wire to strap.
    a) Factory installed suspension systems are acceptable
7. Do not crimp flexible ductwork against joist or truss members, pipes, conduits, etc.
8. Install flexible ductwork with bend radius at the center line equal to or greater than one duct diameter.
    a) Support bends approximately one duct diameter on both sides of bends.
9. Connect flexible ductwork to sheet metal ductwork and air devices with at least 1" overlap.

K. Provide rigid duct elbow or flexible elbow assembly where a 90 degree elbow is required at connection to air devices.

L. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

B. After start-up, final corrections and balancing of systems, test duct silencers by taking octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations, as directed. Refer to Division 23 Section “Testing, Adjusting and Balancing of HVAC” for additional requirements.

1. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements.
2. Submit complete report of test results including sound curves.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

B. Label access doors in accordance with Division-23 section "Identification for HVAC Piping and Equipment".

C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing for HVAC".

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

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