|  |  |  |
| --- | --- | --- |
| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | November 16, 2009 | Modified ‘Related Sections’ |
| 3 | March 16, 2011 | Minor edits |
| 4 | December 10, 2014 | First draft review (AV) |
| 5 | June 8, 2015 | Second Draft for Review (AV) |
| **6** | **September 16, 2015** | **Updated, Finalized Specification – Reference eDOCS #5823630-v5 (AV)** |
| 7 | June 6, 2017 | Updated references to standards ANSI/AMCA 500-L-12 (Rev. 2015), ASTM A123/A123M-15, ASTM A153/A153M-16A, ASTM A240/A240M-16A, ASTM A480/A480M-16b, ASTM A563-15 ASTM A568/A568M-15, ASTM A653/A653M-15e1, ASTM A1008/A1008M-16, ASTM A1011/A1011M-15, ASTM C1071-16, ASTM E84-16, ASTM E96/E96M-16, SMACNA 1819-2002, UL 555C, Standard for Ceiling Dampers (2014-12-1606-10-11 edition) **(AAM)** |
| 8 | August 17, 2017 | Updated listed products. Those that were removed were replaced with performance specifications and standards.(CPD PMO, OMM) |
| 9 | January 4, 2018 | 2.2.5.2 Added material requirement for highly corrosive environments (BM) |

NOTE:

This is a CONTROLLED Document. Any documents appearing in paper form are not controlled and should be checked against the on-line file version prior to use.

**Notice:** This Document hardcopy must be used for reference purpose only.

**The on-line copy is the current version of the document.**

# GEneral

## Related Sections

### *[Under "Related Sections", identify other Sections that are related to, and/or dependent on, the work results or information specified elsewhere. The list should be limited to Sections with specific information that the reader might expect to find in this Section, but is specified elsewhere. For example, if hardware for aluminum entrances is specified in the aluminum entrance Section, a cross-reference would be appropriate in the finish hardware Section. The purpose of this cross-referencing is for information only, to aid in finding those other requirements—not to define the scope of the Section.*

### 

### *Cross-referencing here may also be used to coordinate assemblies or systems whose components may span multiple Sections and which must meet certain performance requirements as an assembly or system.*

### *Contractor is responsible for coordination of the Work.*

### *This Section is to be completed/updated during the design development by the Consultant. If it is not applicable to the Section for the specific project, it may be deleted.]*

### *[List Sections specifying installation of products supplied but not installed under this Section and indicate specific items.]*

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Execution requirements for ...[item]... specified under this Section.

### *[List Sections specifying products installed but not supplied under this Section and indicate specific items.]*

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Product requirements for ...[item]... for installation under this Section.

### *[List Sections specifying related requirements.]*

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: [Optional short phrase indicating relationship].

#### Section 01300 – Submittals

#### Section 01425 – Computerized Maintenance Management System Data Requirements

#### Section 01430 – Operation and Maintenance Data

#### Section 01600 – Material and Equipment

#### Section 01640 – Manufacturer’s Services

#### Section 01810 – Equipment Testing and Facility Commissioning

#### Section 07700 – Roof Specialties and Accessories–

#### Section 07840 – Firestopping

#### Section 08331 – Overhead Coiling Doors

#### Section 09900 – Painting and Protective Coatings

#### Section 15080 – Process Piping Insulation

#### Section 15950 – HVAC Systems Testing, Adjusting, and Balancing

#### Division 15 - Mechanical

#### Division 16 – Electrical

## References

*[Delete .1 if Section 01060 – Regulatory Requirements is included in Contract Documents.]*

### Comply with the latest edition of the following statutes, codes, standards, and all amendments thereto:

#### Air Movement and Control Association (AMCA):

##### ANSI/AMCA 500-L-12 (Rev. 2015), Laboratory Methods of Testing Louvers for Rating

#### American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)

##### ASHRAE Handbook.

#### Association of the Nonwoven Fabrics Industry (INDA):

##### IST 80.6, Water Resistance (Hydrostatic Pressure Test). *[Consultant to confirm existence of IST 80.6, consider replacement with ISO 811:1981 – Textile Fabrics – Determination of Resistance to Water Penetration – Hydrostatic Test]*

#### ASTM International (ASTM):

##### ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.

##### ASTM A90/A90M-13, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc Alloy Coatings.

##### ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

##### ASTM A153/A153M-16A Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

##### ASTM A240/A240M-16A, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

##### ASTM A480/A480M-16b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

##### ASTM A563-15, Standard Specification for Carbon and Alloy Steel Nuts.

##### ASTM A568/A568M-15, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

##### ASTM A653/A653M-15e1, Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

##### ASTM A700-14, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment.

##### ASTM A1008/A1008M-16, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

##### ASTM A1011/A1011M-15, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

##### ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

##### ASTM C916-14, Standard Specification for Adhesives for Duct Thermal Insulation.

##### ASTM C1071-16, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

##### ASTM C1139-14, Standard Specification for Fibrous Glass Thermal Insulation and Sound Absorbing Blanket and Board for Military Applications.

##### ASTM E84-16, Standard Test Method for Surface Burning Characteristics of Building Materials.

##### ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.

##### ASTM C 1290-16, flexible fibrous glass blanket insulation used to externally insulate HVAC ducts, Type III.

#### National Fire Protection Association (NFPA):

##### NFPA 90A, 2015 Edition, Standard for the Installation of Air-Conditioning and Ventilating Systems.

##### NFPA 90B, 2015 Edition, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

##### NFPA 255, 2006 Edition, Standard Method of Test of Surface Burning Characteristics of Building Materials.

##### NFPA 259, 2013 Edition, Standard Test Method for Potential Heat of Building Materials.

#### Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA):

##### SMACNA Accepted Industry Practice for Industrial Duct Construction.

##### SMACNA 1981-2008, Seismic Restraint Manual: Guidelines For Mechanical Systems, 3rd Edition

##### SMACNA 1819-2002, Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.

##### SMANCA 016-2012, HVAC Air Duct Leakage Test Manual, 2nd Edition.

#### Underwriters Laboratories Inc. (UL):

##### UL 181, Standard for Factory-Made Air Ducts and Air Connectors (2013-07-25 edition).

##### UL 555, Standard for Fire Dampers (2006-07-12 edition).

##### UL 555C, Standard for Ceiling Dampers (2014-12-16edition).

##### UL 555S, Standard for Smoke Dampers (2014-02-13 edition).

#### Underwriters Laboratories of Canada (ULC).

#### National Fire Code of Canada 2010.

#### National Building Code of Canada 2010.

## Definitions

### Sealing Requirements: For the purpose of duct systems sealing requirements specified in this Section, the following definitions apply:

#### Seams:

##### Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints.

##### All other duct surface connections made on perimeter are deemed to be joints.

#### Joints, duct surface connections including:

##### Girth joints.

##### Branch and sub branch intersections.

##### Duct collar tap-ins.

##### Fitting subsections.

##### Louver and air terminal connections to ducts.

##### Access door, and access panel frames and jambs.

##### Duct, plenum, and casing abutments to building structures.

## Submittals

### Action Submittals, in accordance with Section 01300 - Submittals:

#### Ductwork Accessories:

##### Manufacturer’s Product data including details of materials, construction, dimensions of individual components, installation details, and finishes for the following items:

###### Duct liner.

###### Sealing materials.

###### Dampers; include leakage, pressure drop, and maximum back pressure data.

###### Duct-mounted access panels and doors.

###### Flexible ducts.

###### Sheet metal fasteners.

#### Duct Fabrication Drawings:

##### Drawn after actual Site measurements are obtained.

##### Drawn to a scale not smaller than 1:50, on drawing sheets of the same size as the Contract Drawings, detailing:

###### Fabrication, assembly, and installation details including plans, elevations, sections, details of components, and attachments to other Work.

###### Duct layout, indicating pressure classifications, and sizes in plan view.

###### [For materials handling exhaust duct systems, indicate classification of materials handled.]

###### Duct material and thickness.

###### Fittings and volume control damper installation (both manual and automatic) details.

###### Reinforcing details and spacing.

###### Seam and joint construction details.

###### Penetrations through fire rated and other partitions.

###### Duct accessories and control devices such as automatic dampers, airflow monitors, terminal units, smoke detectors, regulators, air distribution devices, etc.

###### Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

###### Fire and smoke damper installations, including sleeves and duct mounted access doors and panel installations.

###### Coordination with ceiling suspension members.

###### Spatial coordination with other systems installed in same space with duct systems.

###### Coordination of ceiling and wall mounted access doors and panels required for access to dampers and other operating devices.

###### Coordination with ceiling mounted lighting fixtures, air outlets, and inlets.

#### Shop Drawings shall indicate the coordination of ductwork with sprinkler piping and other mechanical and electrical services, and equipment installed under Division 15- MECHANICAL, and Division 16- ELECTRICAL.

### Informational Submittals, in accordance with Section 01300 - Submittals:

#### Sound Attenuators Certified Test Data:

##### Dynamic insertion loss.

##### Self noise power levels.

##### Static pressure loss.

##### Dimensions and weights.

## Quality Assurance

### Industry Standards:

#### Unless otherwise indicated or specified in the Contract Documents, sheet metal ductwork shall be constructed and installed in accordance with the SMACNA duct construction standard relevant to ductwork system being provided. These standards are referenced in this Section as the SMACNA Manual, unless otherwise indicated in the Contract Documents.

#### Comply with the ASHRAE Fundamentals Handbook recommendations, except as otherwise indicated in the Contract Documents.

#### NFPA Compliance: NFPA 90A, 2015 Edition and NFPA 90B, 2015 Edition.

### Manufacturers: Firms regularly engaged in manufacture of ductwork products of the types, materials, and sizes required, whose products have been satisfactorily used in similar service for a minimum of 5 years.

### Ensure that the suppliers of duct and fitting components provide, on request, the following information:

#### Laboratory performance data for duct, including leakage rate, bursting strength, collapse strength, seam strength, and pressure loss.

#### Laboratory performance data for fittings, including zero length dynamic losses.

### The installer shall be a firm with a minimum of 3 years of experience of successful installation on ductwork systems similar to that required for this Contract.

### Changes or alterations to layout or configuration of duct system shall be:

#### Specifically approved in writing by the Consultant.

#### Proposed layout shall provide original design results, without increasing system total pressure.

## Extra Materials

### Furnish, tag, and box for shipment and storage the following[spare parts,] [special tools,] [and] [materials:]

|  |  |
| --- | --- |
| Item | Quantity |
| Fusible Links | 10% of amount installed |
| **[     ]** | [**One] [     ]** complete set **[per unit]** |
| **[     ]** | **[One] [     ]** complete set **[per unit]** |
| **[     ]** | **[One] [     ]** complete set **[per unit]** |
| **[Special tools required to maintain or dismantle]** | **[One] [     ]** complete set **[for each different size unit]** |

### Delivery: In accordance with Section 01600 - Materials and Equipment.

## Delivery, Storage and Handling

### Protect ductwork from dirt, water, and debris. During storage on the Site, keep ends of ductwork covered to prevent foreign objects and water from entering ductwork.

### Deliver sealant materials to the Site in their original unopened containers labeled with the manufacturer, Product name and designation, colour, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

### Provide MSDS for all applicable materials to Consultant prior to delivery to Site.

### Store and handle sealant materials in compliance with the manufacturers’ recommendations to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

### Deliver and store stainless steel sheets with mill applied adhesive protective paper, maintained through fabrication and installation.

## Measurement and Payment

*[Choose one of the following payment language provisions that best suits the individual project.*

*If this Section is not specifically referenced by an item in the Bid Form, please use the following language:*

.1 The work of this Section will not be measured separately for payment. All costs associated with the work of this Section shall be included in the Contract Price.

*OR If this Section is specifically referenced in the Bid Form, use the following language and identify the relevant item in the Bid Form:*

.1 All costs associated with the work of this Section shall be included in the price(s) for Item No(s). \_\_\_ in the Bid Form.

*If the work of this Section is to be measured and paid for by several different methods, please amend the standard wording given above to reflect the different methods of measurement and payment.]*

# PRODUCTS

## General

### Specified components of this ductwork system, including facings, mastics, and adhesives, shall have a maximum fire hazard rating of 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per testing, conducted in accordance with ASTM E84-16b and NFPA 255, 2006 Edition methods.

### Internally Lined Ductwork: Duct sizes indicated for internally lined ducts are the clear inside dimensions, and shall be increased in both dimensions by twice the thickness of the liner.

### Ductwork Interior Surfaces:

#### Smooth.

#### No sheet metal parts, tabs, angles, screws, or other items may project into air ducts, unless otherwise specified in the Contract Documents.

#### Seams and joints shall be external.

## Sheet Metal Materials

### Construct metal duct systems from [materials as indicated in the Ductwork Schedule attached as a supplement to this Section] [galvanized steel] [aluminum] [Type [304] [316] [stainless steel] [carbon (black) steel].

### Where no specific ductwork materials are indicated in the Specification Sections or on the Contract Drawings, galvanized steel sheet metal shall be utilized.

### Galvanized Steel Ductwork:

#### Comply with the requirements of ASTM A653/A653M-15E1ASTM A653/A653M-15E1.

#### Galvanized steel sheet, lock forming quality, zinc coating designation G90 in conformance with ASTM A90/A90M-13.

#### Sheet metal shall bear LFQ and G90 marks.

#### Provide mill phosphatized finish for ducts which are exposed to view and for ducts which are scheduled to be painted.

#### Provide sheet metal packaged and marked as specified in ASTM A700-14.

### Aluminum Ductwork:

#### Comply with the requirements of ASTM B209-14.

#### Aluminum Sheet: Alloy 3003 H14, unless indicated otherwise in the Contract Documents.

#### Aluminum Connectors and Bar Stock: Alloy 6061 T6 or equivalent.

### Stainless Steel Ductwork:

#### Comply with the requirements of ASTM A240/A240M-16a, and ASTM A480-14b.

#### Stainless Steel Sheet: Type 304, unless indicated otherwise. For highly corrosive environments (i.e. where chlorine is housed), Type 316 shall be used.

#### Gauge shall comply with the requirements of SMACNA standards and manuals, unless specified otherwise in the Contract Documents.

#### Finish: No. 2 B (cold rolled, bright) finish [except as otherwise noted in the Contract Documents].

#### [With No.4 finish on exposed surface for ducts exposed to view.]

### [Carbon (Black) Steel Ductwork: Comply with ASTM A1008/A1008M-16, ASTM A1011/A1011M-15, or ASTM A568-15.]

### Exposed Ductwork: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discoloration, and other imperfections, including those which would impair painting.

### Reinforcement Shapes and Plates: Unless otherwise indicated in the Contract Documents, provide reinforcements of same material as ductwork.

## Duct Sealing Materials

### General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

### Adhesives, Cements, Sealant, and Installation Accessories: As recommended by the duct manufacturer for the application.

### [Solvent Based Sealants:

#### Ultraviolet light resistant.

#### Mildew resistant.

#### Flashpoint: Greater than 21 degrees C, SETA CC (closed cup testing method, commonly known as Setaflash).

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent]

### [Water Based Sealants:

#### Listed by the manufacturer as non-flammable in wet and dry state.

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent]

## Firestopping

### Refer to Section 07840 - Firestopping.

## Ductwork Fasteners

### General:

#### Rivets, bolts, or sheet metal screws

#### Ductwork fasteners shall be of the same metal as the duct being supported, unless otherwise noted in the Contract Documents.

### Self Drilling Screws:

#### Sheet metal screws:

##### Screws shall be formed from [treated [Marutex® stainless steel with strength of Type 410 stainless steel and corrosion resistance of Type 304 stainless steel] [Type 410 stainless steel][ heat treated carbon steel with zinc electroplated finish].

##### Shall have a minimum shear of [ ].

##### Shall have a minimum tensile strength of [ ].

## Ductwork Pressure Class

### Construct duct systems to the pressure classifications indicated [A: in Ductwork Schedule] [B: as follows:

#### Supply Ducts: [   ] Pa, positive pressure.

#### Return Ducts: [   ] Pa, negative pressure.

#### Exhaust Ducts: [   ] Pa, negative pressure.]

### Where no specific duct pressure designations are indicated in the Specification Sections or on the Contract Drawings, 500 Pa pressure class shall be utilized as the basis of the Contract and as approved by the Consultant.

## Rectangular Ductwork

### Fabricate rectangular ducts in accordance with SMACNA [HVAC Duct Construction Standards, Metal and Flexible,] [Rectangular Industrial Duct Construction Standards], unless otherwise specified in the Contract Documents.

### Crossbreaking or Cross Beading:

#### Crossbreak or bead duct sides that are 480 mm and larger and are 20 gauge or less, with more than 1.0 square metre of unbraced panel area, as indicated in the SMACNA standards and manuals, unless they are lined or are externally insulated.

### [Air Handling Unit Discharge Ductwork: Ductwork extending from variable air volume air handling units up to and including first elbow or terminal tap outside air handling unit room shall be constructed [of 16 gauge, minimum ] [of sheet metal, same material as remainder of system.] [as specified on the Contract Drawings.]

## Rectangular Ductwork Fittings

### Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA [HVAC Duct Construction Standards, Metal and Flexible] [Rectangular Industrial Duct Construction Standards].

### Elbows:

#### Fit square turn elbows with vane side rails.

#### Shop fabricate double-blade turning vanes of same material as ductwork.

#### Fabricate with equal inlet and outlet.

#### Rectangular radius elbows with an inside radius of 75% of the duct width in the direction of the turn.

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

## Rectangular Ductwork Insulation Liner

### Location: Provide ductwork with internal insulation liner where indicated on Contract Drawings or in the Ductwork Schedule attached as a supplement to this Specification Section (See 15810-01 Ductwork Schedule).

### Material:

#### Fiberglass, nominal 24.0 kg/m3 density liner, K factor 0.035 maximum at 24 degrees C mean, black composite coated surface exposed to airstream to prevent erosion of glass fibers, for temperatures to 121 degrees Celsius.

#### Liquid water repellency rating not less than four when tested in accordance with INDA IST 80.6 *[Consultant to confirm existence of IST 80.6, consider replacement with ISO 811:1981 – Textile Fabrics – Determination of Resistance to Water Penetration – Hydrostatic Test]*.

#### Potential heat value not exceeding 2,250 watt hr per kg when tested in accordance with NFPA 259, 2013 Edition and meeting classification of “Limited Combustible” as defined by NFPA 90A, 2015 Edition.

#### Maximum rated velocity not less than 30 m/s when tested in accordance with ASTM C1071-16.

#### Resistant to microbial growth using a “no growth criteria” when tested in accordance with ASTM C1139-14.

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

### Thickness: Minimum [25] mm or greater thickness where indicated on the Contract Drawings or in the Ductwork Schedule attached as a supplement to this Specification Section (See 15810-01 Ductwork Schedule).

### Liner Adhesive: In accordance with NFPA 90A, 2015 Edition and ASTM C916-14.

### Mechanical Fasteners:

#### Same material as ductwork, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.

#### Provide fasteners that do not damage liner when applied as recommended by the manufacturer, that do not cause leakage in duct, and will indefinitely sustain 223 N tensile dead load test perpendicular to duct wall.

#### Fastener Pin Length: As required for thickness of insulation and without projecting more than 3 mm into airstream.

#### Adhesive for Attachment of Mechanical Fasteners: In accordance with Fire Hazard Classification *[Consultant to determine Fire Hazard Classification in accordance to applicable regulations]* of the duct liner system.

### Liner Application:

#### Ductwork liner shall be applied at the time of ductwork manufacture in an approved sheet metal workshop.

#### Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.

#### Apply coat of adhesive to liner facing in the direction of airflow not receiving metal nosing.

#### Butt transverse joints without gaps and coat joint with adhesive.

#### Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.

#### Longitudinal Joints:

##### Shall not occur except at corners of ducts, unless size of duct and standard liner product dimensions make longitudinal joints necessary.

##### Apply adhesive coating on longitudinal seams in ducts exceeding 12.5 m/s air velocity.

#### Secure liner with mechanical fasteners 102 mm from corners and at intervals not exceeding 305 mm transversely around perimeter, at 76 mm from transverse joints, and at intervals not exceeding 457 mm longitudinally.

#### Secure transversely oriented liner edges facing airstream with metal nosing that are either channel or “Z” profile or are integrally formed from duct wall at the following locations:

##### Fan discharge.

##### Intervals of lined duct preceding unlined duct.

##### Upstream edges of transverse joints in ducts.

#### Seal insulation edges.

#### Repair abrasions or tears with mastic.

## Double Wall Ducts with Sheet Metal Liner

### Location: Provide ductwork with internal sheet metal liner where indicated on the Contract Drawings or in the Ductwork Schedule attached as a supplement to this Specification Section (See 15810-01 Ductwork Schedule).

### Secure insulation liner with sheet metal liner of same gauge and material specified for duct, secured to ducts with mechanical fasteners that maintain metal liner distance from duct without compressing insulation.

### Sheet metal liner shall [comprise 3.4 mm diameter perforations, with overall open area of 23 percent] [be continuous, with no insulation liner exposed to airstream] [at locations indicated on Contract Drawings]

### Terminate liner with duct build outs installed in ducts to attach dampers, turning vane assemblies, and other devices.

### Fabricated build outs (metal hat sections) or other build out means are optional; when used, secure build outs to duct wall with bolts, screws, rivets, or welds.

### Terminate liner at fire dampers at connection to fire damper sleeve.

## Rigid Round Ductwork

### Construct rigid round ducts in accordance with SMACNA [HVAC Duct Construction Standards, Metal and Flexible] [Round Industrial Duct Construction Standards], unless specified otherwise in the Contract Documents.

### Basic Round Diameter: As used in this Section, is diameter of size of round duct that has circumference equal to perimeter of a given size of flat oval duct.

### Where space limitations prevent use of round duct or where shown on the Contract Drawings, provide ductwork of flat oval construction.

### Fabricate round ducts with spiral seam construction, except where diameters exceed 1,800 mm. Fabricate ducts having diameters greater than 1,800 mm with longitudinal butt welded seams.

### Single Wall Ductwork: Unless otherwise indicated in the Contract Documents, rigid round shall be of single wall construction.

### Double Wall Ductwork:

#### As indicated on the Contract Drawings or in the Ductwork Schedule attached as a supplement to this Specification Section (See 15810-01 Ductwork Schedule).

#### Constructed as follows:

##### Inner liner:

###### [Solid] [Perforated]sheet metal, same material as outer pressure shell, unless indicated otherwise in the Contract Documents.

###### [Inner liner shall have minimum 3.4 mm diameter perforations, with overall open area of 23 percent.]

##### Void space between liner and outer pressure shell shall be filled with [fibreglass] [elastomeric] insulation, minimum 25 mm thickness or greater as indicated on Contract Drawings or in the Ductwork Schedule (attached as a supplement to this Specification Section).

##### Outer shell gauge shall be based upon actual outer shell dimensions.

##### Provide insulation ends where internally lined ductwork connects to single wall ductwork or to any non-insulated component.

### [Ductwork seams of Snaplock type shall not be used.] [Snaplock seams may only be used for duct systems of construction pressure classification less than 500 Pa.]

## Rigid Round Ductwork Fittings

### Construct rigid round ductwork fittings in accordance with SMACNA [HVAC Duct Construction Standards, Metal and Flexible] [Round Industrial Duct Construction Standards], unless otherwise specified in the Contract Documents.

### 90 Degree Tees, Laterals, and Conical Tees: Fabricate to conform to SMACNA standards and manuals with metal thicknesses specified for longitudinal seam straight duct.

### Diverging Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.

### Elbows:

#### Fabricate in stamped (die formed), pleated, or segmented (gored) construction 1.5 times elbow diameter. Two piece segment elbows are not allowed, except with turning vanes.

#### Segmented Elbows: Fabricate with welded construction.

#### Round Elbows 200 mm and Smaller:

##### Stamped elbows for 45 and 90 degree elbows and pleated elbows for 30, 45, 60, and 90 degrees configuration.

##### Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 90 and 115 mm) elbows with segmented construction.

#### Round Elbows 225 mm Through 350 mm:

##### Segmented or pleated elbows for 30, 45, 60, and 90 degrees.

##### Fabricate nonstandard bend angle configurations or non-standard sized (for example, 240 and 265 mm) elbows with segmented construction.

## Fiberglass Ductboard

### Fabricate in accordance with the SMACNA Fibrous Glass Duct Construction Standards.

### 25 mm thick fibreglass ductboard with exterior vapour barrier.

### UL 181 Listed for 25 m/s velocity, with a factory applied, thermosetting, biocide treated acrylic polymer coating to airstream side.

### K equals 0.033 at 24 degrees Celsius mean, and Noise Reduction Coefficient (NRC) of 0.80 as tested on Type A mounting.

### Manufacturers and Products:

#### *[Consultant to provide names of three approved products]*

#### Approved Equivalent

## Round Fiberglass Duct

### Duct wrap:

#### Minimum fibreglass thickness : 25 mm

#### UL recognized and listed

#### Complies with ASTM C 1136

#### Minimum R-value of 8.

### One piece construction with pre-molded slip joints, 2,000 mm sections.

### Scrim reinforced aluminum jacket on outside and acrylic coating on inside.

### K equals 0.033 at 24 degrees Celsius mean and NRC (Noise Reduction Coefficient) of 0.80 as tested on Type A mounting.

### Fittings: Sheet metal fabricated as follows:

#### Miter and saddle cuts made with band saw.

#### Reducers cut with alligator notcher designed specifically for that purpose.

#### Gores: Glue and seal must comply with ASTM C916 and NFPA 90A, 2015 Edition and NFPA 90B, 2015 Edition.

### Manufacturer and Product:

#### *[Consultant to provide names of three approved products]*

#### Approved Equivalent

## Fiberglass Ductboard Fittings

### Round takeoffs from rectangular fibreglass duct shall be made with Twist Lock fittings.

### Manufacturers:

#### *[Consultant to provide names of three approved products]*

#### Approved Equivalent

## Insulated Flexible Duct

### Fabricate in accordance with:

#### UL 181, Class 1.

#### NFPA 90A, 2015 Edition and NFPA 90B, 2015 Edition.

### Construction:

#### Outer Jacket: Fire retardant reinforced aluminum vapour barrier jacket with reinforced cross hatched scrim having a permeance of not greater than 0.1 perm when tested in accordance with ASTM E96/E96M-16, Procedure A *[Consultant to confirm details to reference].*

#### Inner Liner: Tri laminate of aluminum foil, fibreglass, and aluminized polyester.

#### Reinforcing: Galvanized steel wire helix, mechanically locked to and encapsulated by inner liner fabric.

#### Insulation:

##### Factory insulated with fibreglass insulation.

##### R value: 1.05 m2 k/w minimum at a mean temperature of 24 degrees Celsius.

#### Internal Working Pressure: Rating shall be minimum 1,500 Pa positive and 1,000 Pa negative, with bursting pressure of at least 2.5 times working pressure.

#### Air Velocity Rating: 20 m/s, minimum.

### Environment: Suitable for continuous operation at temperature range of minus 29 degrees Celsius to plus 121 degrees Celsius.

### Manufacturers and Products:

#### *[Consultant to provide names of three approved products]*

#### Approved Equivalent

## High Temperature Flexible Ductwork

### Metal flexible ductwork for high heat applications.

### Fully interlocked, stainless steel, 0.305 mm thickness.

### Manufacturers and Products:

#### *[Consultant to provide names of three approved products]*

#### Approved Equivalent

## Ductwork Hangers and Supports

### General:

#### Attachments, hangers, and supports for ductwork shall be in accordance with the SMACNA Manual referenced for the type of duct system being installed.

#### Duct hanging system shall be composed of three elements; upper attachment to building, hanger itself, and lower attachment to duct.

#### Wire hangers are not acceptable.

#### Hanger Spacing:

##### Ducts Up to 1,500 mm in Largest Dimension: 3.0 m, maximum.

##### Ducts Over 1,525 mm in Largest Dimension: 2.4 m, maximum.

### Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, and bolts shall be as follows:

##### Galvanized Steel Ductwork:

###### Indoors: Carbon steel, zinc electroplated.

###### Outdoors: Carbon steel, hot dipped galvanized after fabrication.

##### Aluminum Ductwork Indoors and Outdoors: Carbon steel, hot dipped galvanized after fabrication.

##### Stainless Steel Ductwork Indoor and Outdoors: Stainless steel, same ASTM Grade as ductwork.

##### [Carbon (Black) Steel Ductwork:

###### Indoors: Carbon steel, zinc electroplated.

###### Outdoors: Carbon steel, hot dipped galvanized after fabrication.]

### Building Attachments:

#### Concrete inserts, powder actuated fasteners, or structural steel fasteners which are appropriate for building materials.

#### Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 102 mm thick.

#### Upper Attachment (Concrete):

##### Drive pin fastener and expansion nail anchor may be used for ducts up to 450 mm in largest dimension.

##### Threaded stud fastener may be used for ducts up to 900 mm in largest dimension.

##### Concrete attachments shall be made of steel.

### Duct Fasteners: Sheet metal screws, blind rivets, or self tapping metal screws; compatible with duct materials and conforming to requirements of subsection 2.5 - Ductwork Fasteners, above.

### Trapeze and Riser Supports: Steel shapes conforming to the requirements of ASTM A36/A36M-14, hot dipped galvanized after fabrication.

## Flexible Connections

### Materials:

#### Flame retardant or non-combustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

#### Outdoor flexible connectors coated with Hypalon (chlorosulfonated polyethylene synthetic rubber) for UV protection.

### Metal Edged Connectors:

#### Construct from same material as the ductwork, unless noted otherwise in the Contract Documents.

#### Fold and crimp metal edge strips onto fabric as illustrated in the appropriate SMACNA Manuals and standards.

#### Standard Metal Edged Connectors: Factory fabricated with strip of fabric 90 mm wide attached to two strips of 70 mm wide sheet metal.

#### Extra Wide Metal Edged Connectors: Factory fabricated with strip of fabric 146 mm wide attached to two strips of 70 mm wide sheet metal.

#### Transverse Metal Edged Connectors: Factory fabricated with strip of fabric 90 mm wide attached to two strips of 111 mm wide sheet metal.

### Manufacturers and Products:

#### *[Consultant to provide names of three approved products]*

#### Approved Equivalent

## Ceiling Access Doors

### As specified in Section 08331 – Overhead Coiling Doors.

### [Size: 750 mm by 750 mm.]

### Finish in baked white enamel.

## Duct Inspection Doors

### General:

#### Insulated, gasketed, and at least 375 mm by 375 mm when duct dimensions are large enough.

#### On ductwork where largest side dimension is less then 400 mm, furnish inspection doors at least 200 mm by 200 mm.

#### Complete with necessary hardware.

#### Fabricated of same material as ductwork [or galvanized steel for fiberglass ductboard].

### Round Spin in Type Access Doors:

#### Size: 450 mm and 600 mm diameter will be acceptable in lieu of comparably sized square or rectangular access doors specified in this Section.

#### Complete with insulation, spin in frame, inner door, attachment cable, gaskets, three latches, and pull ring.

### Casing and Plenum Access Doors:

#### Size: 1425 mm high by 600 mm wide minimum where possible.

#### Complete with hardware, hinges, seals, and latch handles.

### Manufacturers:

#### *[Consultant to provide names of three approved products]*

#### Approved Equivalent

## Manual Dampers

### Butterfly Manual Dampers:

#### Fabricate from two gauges heavier than duct in which installed, of same material as ductwork [or galvanized steel in fiberglass duct board].

#### Align operating handle with damper blade.

#### Provide 50 mm standoff bracket for insulated duct systems.

#### Damper Manufacturers:

##### [*Consultant to provide names of three approved products]*

##### Approved Equivalent

### Manual Opposed Blade Balancing Dampers:

#### Externally operated gang airfoil, damper blades.

#### Fabricate from same material as ductwork.

#### Stainless steel or nylon sleeve bearings.

#### Construction shall have interlocking edges and maximum 250 mm blade width.

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

## Backdraft Dampers

### General:

#### Damper pressure drop ratings shall be based on tests and procedures performed in accordance with ANSI/AMCA 500-L-12 (Rev. 2015).

### Aluminum Counterbalanced Back Draft Dampers (BDD A)

#### Fabrication:

##### Frame: 51 mm by minimum 1.5 mm, 6063 T5 extruded aluminum channel with [front flange and] [rear flange and] mitered corners.

##### Blades:

###### Style: Single piece, overlap frame.

###### Action: Parallel.

###### Material: Minimum 0.6 mm 6063 T5 formed aluminum.

###### Width: Maximum 152 mm.

##### Bearings: Corrosion resistant, long life, synthetic, formed as single piece with axles.

##### Blade Seals: Extruded vinyl, mechanically attached to blade edge.

##### Linkage: Concealed in frame.

##### Axles: Corrosion resistant, long life, synthetic, locked to blade and formed as single piece with bearings.

##### Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade enabling damper to operate over wide range of pressures.

##### Mounting:

###### Suitable for mounting in vertical, horizontal airflow up, and horizontal airflow down positions.

###### Configured for [Vertical] [Horizontal, airflow up] [Horizontal, airflow down] [positions as shown on Contract Drawings].

##### Finish: [Mill aluminum.] [Factory applied air dried epoxy paint on all damper parts.]

#### Performance Data:

##### Temperature Rating: Withstand minus 40 degrees to 93 degrees Celsius.

##### Maximum Back Pressure: 500 Pa.

##### Maximum Spot Air Velocity: 5 m/s.

##### Operation of Blades:

###### Start to Open: 2.5 Pa.

###### Fully Open: 15.0 Pa.

##### Pressure Drop: Maximum 10.0 Pa at 5.0 m/s through 600 mm by 600 mm damper.

#### Accessories:

##### [Duct Transition Connection: [Round.] [Oval.] [Rectangular.]

##### [Factory Sleeve: Minimum 20 gauge (1.0 mm) thickness, minimum 305 mm length.]

##### [Screen:

###### Type: [Bird.] [Insect.]

###### Location: [Front with sleeve.] [Rear with sleeve.]

###### Material: [Galvanized steel.] [Aluminum.] [     .]]

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

### Heavy Duty Aluminum Counterbalanced Back Draft Dampers (BDD H)

#### Fabrication:

##### Frame: 57 mm by minimum 3.2 mm 6063 T5 extruded aluminum channel with [front flange and] [rear flange and] galvanized steel braces at mitered corners.

##### Blades:

###### Style: Single piece, overlap frame.

###### Action: Parallel.

###### Orientation: Horizontal.

###### Material: Minimum 1.8 mm 6063 T5 extruded aluminum.

###### Width: Maximum 152 mm.

##### Bearings: Corrosion resistant, long life, synthetic, formed as single piece with axles.

##### Blade Seals: Extruded vinyl, mechanically attached to blade edge.

##### Linkage: Minimum 13 mm aluminum tie bar with stainless steel pivot pins mounted on blades.

##### Axles: Corrosion resistant, long life, synthetic, locked to blade and formed as single piece with bearings.

##### Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade enabling damper to operate over wide range of pressures.

##### Mounting:

###### Suitable for mounting in vertical, horizontal airflow up, and horizontal airflow down positions.

###### Configured for [Vertical] [Horizontal, airflow up] [Horizontal, airflow down] [positions as shown on Contract Drawings].

##### Finish: [Mill aluminum.] [Factory applied air dried epoxy paint on all damper parts.] [Factory applied anodizing on all aluminum damper parts.]

#### Performance Data:

##### Temperature Rating: Withstand minus 40 to 93 degrees Celsius.

##### Maximum Back Pressure: 4 kPa.

##### Maximum Air Velocity: 12.7 m/s.

###### Operation of Blades:

Start to Open: 2.5 Pa.

Fully Open: 12.5 Pa.

##### Pressure Drop: Maximum 38 Pa at 7.6 m/s through 600 mm by 600 mm damper.

#### Accessories:

##### [Duct Transition Connection: [Round] [Oval] [Rectangular].]

##### [Factory Sleeve: Minimum 20 gauge (1 mm) thickness, minimum 305 mm length.]

##### [Screen:

###### Type: [Bird.] [Insect.]

###### Location: [Front with sleeve.] [Rear with sleeve.]

###### Material: [Galvanized steel.] [Aluminum.] [     .]]

#### Manufacturer and Product:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

## Fire, Fire/Smoke, Smoke Dampers

### Duct Mounted Fire Dampers in Fire Walls with Rating of 2 Hours or Less:

#### NFPA 90A, 2015 Edition rated for 1.5 hour service.

#### Blades, frame, and mounting angles same material as ductwork.

#### Accordion style folded blades.

#### 74 degrees Celsius fusible link.

#### Approved for installation with 2 hour fire rating.

#### Rated, manufactured, tested, and approved in accordance with UL 555.

#### [Blades out of airstream when open (Type B).] [Blades in airstream when open (Type A).]

#### Furnish with sleeved frame for duct connections.

#### Labeled for use in [static] [dynamic] mode.

#### Furnish dynamic and horizontal mounted dampers with springs for proper closure.

#### Corrosive Service Dampers: Type 316 stainless steel.

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

### Duct Mounted Fire Dampers in Walls with 3 Hour or Greater Fire Rating:

#### NFPA 90A, 2015 Edition rated for 3 hour service.

#### Blades, frame, and mounting angles.

#### Accordion style folding blades.

#### 74 degrees Celsius fusible link.

#### Approved for installation in 4 hour wall.

#### Rated, manufactured, tested, and approved in accordance with UL 555.

#### [Blades out of airstream when open (Type B).] [Blades in airstream when open (Type A).]

#### Furnish with sleeved frame for duct connection.

#### Labeled for use in [static] [dynamic] mode.

#### Furnish dynamic and horizontal mounted dampers with springs for proper closure.

#### Corrosive Service Dampers: Type 316 stainless steel.

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

### Ceiling Grille and Diffuser Fire Dampers:

#### UL Listed assembly with frame.

#### Butterfly type blades.

#### 74 degrees Celsius fusible link.

#### Radiation type damper.

#### Manufacturers and Products:

##### [*Consultant to provide names of three approved products]*

##### Approved Equivalent

### Combination Fire/Smoke Dampers:

#### General:

##### UL Listed according to UL 555S.

##### UL Listed for 1.5 hour rating according to UL 555.

##### As part of UL qualification, smoke dampers shall have demonstrated capacity to operate (to open and close) under HVAC system operating conditions, with pressures up to 1,000 Pa in closed position, and 10.0 m/s air velocity in open position.

#### Fusible Link: Replaceable, 74 degrees Celsius.

#### Bearings: Stainless steel sleeve turning in extruded hole in frame. Galvanized bearings are not acceptable.

#### Controlled Closure: Heat actuated release device to prevent duct and HVAC component damage. Instantaneous damper closure is unacceptable.

#### Leakage Class: In accordance with UL 555S [Class IV (305 L/s per square metre at 250 Pa)] [Class III (203 L/s per square metre at 250 Pa)] [Class II (51 L/s per square metre at 250 Pa)] [Class I (19 L/s per square metre at 250 Pa)].

#### Damper Actuator: UL 555S, suitable for[120V ac] [24V ac] power supply.

#### Frame and Blades: 16 gauge galvanized steel.

#### Mounting Sleeve: Factory installed, 18 gauge galvanized steel, length to suit wall or floor application.

#### Manufacturer and Product:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

### Smoke Dampers:

#### General:

##### UL Listed according to UL 555S.

##### As part of UL qualification, smoke dampers shall have demonstrated capacity to operate (to open and close) under HVAC system operating conditions, with pressures up to 1,000 Pa in closed position, and 10 m/s air velocity in open position.

#### Bearings: Stainless steel sleeve turning in extruded hole in frame. Galvanized bearings are not acceptable.

#### Controlled Closure: Heat actuated release device to prevent duct and HVAC component damage. Instantaneous damper closure is unacceptable.

#### Leakage Class: [Class IV (305 L/s per square metre at 250 Pa)] [Class III (203 L/s per square metre at 250 Pa)] [Class II (51 L/s per square metre at 250 Pa)] [Class I (19 L/s per square metre at 250 Pa)].

#### Damper Actuator: UL 555S, suitable for [120V ac] [24V ac] power supply.

#### Frame and Blades: 16 gauge galvanized steel.

#### Mounting Sleeve: Factory installed, 18 gauge galvanized steel, length to suit wall or floor application.

#### Manufacturer and Product:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

## Control Dampers

### General:

#### Specification applies to control dampers, except those specified to be furnished with equipment.

#### Furnish opposed blade type for proportional action and parallel blade type for two position action, except where indicated otherwise in the Contract Documents.

### Standard Duty Control Dampers (M):

#### Frame:

##### Nominal 127 mm x minimum 1.6 mm roll formed, hat shaped channel, reinforced at corners. (Structurally equivalent to 13 gauge (2.3 mm) U channel.)

##### Material: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [Galvanized steel.] [Type 304 stainless steel.]

#### Blades:

##### Style: Single skin with three longitudinal grooves, minimum.

##### Orientation: Horizontal or vertical with thrust washers, as indicated on Drawings.

##### Minimum 14 gauge (2 mm) equivalent thickness.

##### Material: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [Galvanized steel.] [Type 304 stainless steel.]

##### Width: Nominal 152 mm.

#### Bearings: Molded synthetic sleeve, turning in extruded hole in frame.

#### Seals:

##### Blade Seals: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section] [Inflatable PVC coated fibreglass material and galvanized steel.] Mechanically attached to blade edge.

##### Jamb Seals: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [Flexible metal compression type.]

#### Linkage: Concealed in frame.

#### Axles:

##### Minimum 13 mm diameter, hex-shaped, mechanically attached to blade.

##### Material: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [Plated steel.]

#### Performance Data: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, Article Supplements.] [As follows:

##### Temperature Rating: Withstand minus 60 to 177 degrees Celsius.

##### Closed Position: Maximum pressure of 3.2 kPa at a 12 inch blade length.

##### Open Position: Maximum air velocity of 1,829 metres per minute.

##### Leakage: Maximum 0.6 cubic metre per minute per square metre at 0.25 kPa for all sizes 610 mm wide and above.

##### Pressure Drop: Maximum 0.01 kPa at 457 metres per minute across 610 mm by 610 mm damper.]

#### Accessories: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [As follows:

##### Actuator: Refer to subsection 2.26 – Control Damper Operators, below, for requirements.

##### [Switch Package: Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.]

##### [Flange: 38 mm, roll formed as part of frame, [front] [rear] [double] configuration.]]

##### [T-Flange Frame:

###### Minimum 152 by 35 by 3.2 mm aluminum, bolt holes in corners.

###### Mates to: TDC, TDF, Ductmate, Nexus, Ward, and other T-flange duct connections.]

##### [Factory Sleeve: Minimum 20 gauge (1 mm) thickness, minimum 305 mm length.]

##### [Duct Transition Connection: Configuration to suit ductwork cross-section, as shown on the Contract Drawings.]

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

### High Performance Control Dampers (M):

#### Frame: Frame: 127 mm by 25 mm by minimum 3.2 mm 6063 T5 extruded aluminum hat shaped channel, mounting flanges on both sides of frame, reinforced at corners.

#### Blades:

##### Style: Airfoil shaped, single piece.

##### Orientation: Horizontal or vertical with thrust washers, as indicated on Contract Drawings.

##### Material: Heavy duty 6063 T5 extruded aluminum.

##### Width: Nominal 152 mm.

#### Bearings: Molded synthetic sleeve, turning in extruded hole in frame.

#### Seals:

##### Blade Seals: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [Extruded neoprene type for ultra low leakage from minus 58 to 135 degrees Celsius] Mechanically attached to blade edge.

##### Jamb Seals: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [Flexible metal compression type.]

#### Linkage: Concealed in frame.

#### Axles:

##### Minimum 13 mm diameter, hex shaped, mechanically attached to blade.

##### Material: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, Article Supplements.] [Plated steel.]

#### Performance Data: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [As follows:

##### Temperature Rating: Withstand minus 58 to 135 degrees Celsius.

##### Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.

##### Closed Position: Maximum pressure of 3.2 kPa at 305 mm blade length.

##### Open Position: Maximum air velocity of 1,829 metre per minute.

##### Leakage: Maximum 0.6 cubic metre per minute per square metre at 1 kPa for size 1219 by 1219 mm.

##### Pressure Drop: Maximum 0.01 kPa at 457 metres per minute across 610 by 610 mm damper.]

#### Accessories: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [As follows:

##### Actuator: Refer to subsection 2.26 - Control Damper Operators, below, for requirements.

##### [Switch Package: Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.]

##### [Flange Frame: 38 mm, roll formed as part of frame, [front] [rear] [double] configuration.]]

##### [T Flange Frame:

###### Minimum 152 by 35 by 3.2 mm aluminum, bolt holes in corners.

###### Mates to TDC, TDF, Ductmate, Nexus, Ward, and other T flange duct connections.]

##### [Factory Sleeve: Minimum 20 gauge (1 mm) thickness, minimum 305 mm length.]

##### [Duct Transition Connection: Configuration to suit ductwork cross section, as shown on the Drawings.]

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

### Heavy Duty Control Dampers (M):

#### Frame:

##### 203 mm by 51 mm by minimum 2 mm channel.

##### Bolt Holes: [One flange.] [Both flanges].

##### Material: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [Galvanized steel.] [Type 304 stainless steel.] [Type 316 stainless steel.]

#### Blades:

##### Style: Airfoil shaped, double skin.

##### Orientation: Horizontal or vertical with thrust washers, as indicated on Contract Drawings.

##### Minimum 14 gauge (2 mm) equivalent thickness.

##### Material: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [Galvanized steel] [Type 304 stainless steel.] [Type 316 stainless steel.]

##### Width: 127 mm to 203 mm maximum.

#### Bearings: [Stainless steel sleeve pressed into frame.] [Stainless steel sleeve in cast housing bolted to frame.] [Bolted to frame with shaft seal.] [Outboard bearings with shaft seal.]

#### Seals:

##### Blade Seals: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [EPDM blade seals, maximum 121 degrees Celsius.] [ Silicone blade seals, maximum 177 degrees Celsius.] [Stainless steel blade seals, maximum 204 degrees Celsius.] Mechanically attached to blade edge.

##### Jamb Seals: Compressible stainless steel located between blade edge and jamb.

#### Linkage:

##### [Side linkage out of airstream.] [Face linkage in airstream.]

##### Constructed of minimum 10 gauge (3.5 mm) galvanized steel clevis arms with minimum 4.8 mm by 19 mm plated steel tie bars pivoting on minimum 9.5 mm diameter stainless steel pivot pins with lock-type retainers.

#### Axles:

##### Minimum [13 mm] [19 m] diameter, hex-shaped, mechanically attached to blade.

##### Material: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section] [Plated steel.] [Type 304 stainless steel.] [Type 316 stainless steel.]

#### Performance Data: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [As follows:

##### Maximum Operating Temperature: [121 degrees Celsius.] [ .]

##### Maximum System Pressure: 2.5 kPa.

##### Maximum System Velocity: 1,219 metre per minute.

##### Leakage with Seals: Based on pressure differential of 0.25 kPa.

###### Percent of Maximum Flow: 0.10.

###### Leakage: 1.2 cubic metres per minute per square metres.

##### Leakage without Seals: Based on pressure differential of 0.25 kPa.

###### Percent of Maximum Flow: 0.80.

###### Leakage: 9.7 cubic metres per minute per square metres.

##### Ultra-Low Leakage:

###### Percent of Maximum Flow: 0.07.

###### Leakage: 0.8 cubic metre per minute per square metre.]

#### Accessories: [As scheduled on the Contract Drawings.] [As scheduled in the Control Damper Schedule, attached as a supplement to this Section.] [As follows:

##### Actuator: Refer to subsection 2.26 - Control Damper Operators, for requirements.

##### [Switch Package: Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.]]

#### Manufacturers and Products:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

## Control Damper Operators

### General:

#### Contract Drawings and Control Diagrams indicate only one damper motor for each motorized damper (M).

#### Select actual quantity of motors required to operate each damper in accordance with size of damper provided.

#### Coordinate exact quantity of damper motors with electrical work to ensure that necessary wiring and conduit is provided for installation.

#### Provide operators for motorized dampers and motorized louvers.

### Electric Damper Operators:

#### Performance: [As scheduled on the Contract Drawings.] [As scheduled in the Motorized Damper Schedule, attached as a supplement to this Section.] [As follows:

##### [120V, 60 Hz, two-position] [24V, 60 Hz, two-position] [24V, 60 Hz, modulating] [ ].

##### Fail Position: [Open.] [Closed]].

#### Mounting: [External side plate.] [External sleeve.] [In airstream.]

#### Ample power to overcome friction of damper linkage and air pressure acting on damper blades.

#### Furnished with external adjustable stops to limit stroke.

#### Operators on modulating dampers that are to be sequenced with other control devices shall have full relay type pilot positioner and interconnecting linkage to provide mechanical feedback that will accurately position and control damper.

#### Intake, relief, and exhaust dampers shall close and return dampers shall open on control failure, unless indicated otherwise in the Contract Documents.

#### Operating Torque:

##### Provide multiple independent damper sections, each with separate actuator, as needed to provide minimum of 120 percent of operating torque required by the damper(s).

##### Required damper operating torque for actuator sizing calculations shall include friction of damper linkage and 200 Pa air pressure on damper blades:

###### Opposed Blade Dampers: Minimum 6 Nm per square metre of damper area, unless higher values are recommended by damper manufacturer.

###### Parallel Blade Dampers: Minimum 8.5 Nm per square metre of damper area, unless higher values are recommended by the damper manufacturer.

#### Manufacturers:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

### Pneumatic Damper Operators:

#### Performance: [As scheduled on the Contract Drawings.] [As scheduled in the Motorized Damper Schedule, attached as a supplement to this Section.] [As follows:

##### 138 to 207 kPa supply air pressure, [two position] [modulating] [ ].

##### Fail Position: [Open] [Closed]].

#### Mounting: [External side plate.] [External sleeve.] [In airstream.]

#### Pneumatic Operators:

##### Synthetic elastomer diaphragm piston type.

##### Fully proportioning, unless otherwise specified.

#### Ample power to overcome friction of damper linkage and air pressure acting on damper blades.

#### Furnished with external adjustable stops to limit stroke.

#### Operators on modulating dampers that are to be sequenced with other control devices shall have full relay type pilot positioner and interconnecting linkage to provide mechanical feedback that will accurately position and control damper.

#### Sized to provide modulating or two position action as required.

#### Intake, relief, and exhaust dampers shall close and return dampers shall open on control failure, unless indicated otherwise in the Contract Documents.

#### Operating Torque:

##### Provide multiple independent damper sections, each with separate actuator, as needed to provide a minimum of 120 percent of operating torque required by the damper(s).

##### Required damper operating torque for actuator sizing calculations shall include friction of damper linkage and 250 Pa air pressure on damper blades:

###### Opposed Blade Dampers: Minimum 6 Nm per square meter of damper area, unless higher values are recommended by the damper manufacturer.

###### Parallel Blade Dampers: Minimum 8.5 Nm per square metre of damper area, unless higher values are recommended by the damper manufacturer.

#### Manufacturers:

##### *[Consultant to provide names of three approved products]*

##### Approved Equivalent

## Sound Attenuators

### Packed Type:

#### Fabricate from a minimum of 22 gauge sheet metal of the same material as ductwork.

#### Furnish perforated interior partitions with moisture resistant mineral fibre carrying a maximum NFPA 255, 2006 Edition Flame Spread Index of 20.

#### Pressure rated airtight at 1,500 Pa.

#### Furnish vapor barrier lining on inside face of sound trap.

#### Size and Performance: As indicated on Contract Drawings or in the Sound Attenuator Schedule, attached as a supplement to this Section.

### Pack-less Type:

#### Low frequency pack-less rectangular sound attenuators to reduce sound transmission to occupied spaces.

#### Modular, consisting of [6 gauge] [18 gauge] [20 gauge] [22 gauge] steel outer casing and [18 gauge] [22 gauge] [24 gauge] [26 gauge] fabricated steel interior members that have been hot dip galvanized.

#### Assembled with lock formed airtight seams, which shall remain airtight to a pressure of 2,500 Pa.

#### Contain no glass fibre, foam, or other porous material as fill, but shall depend on internal design to achieve sound attenuation.

#### Exhibit dynamic insertion loss not less than specified and pressure drop under design airflow shall not exceed the limit determined by the manufacturer.

#### Size and Performance: As indicated on the Contract Drawings or in the Sound Attenuator Schedule, attached as a supplement to this Section.

## External Duct Insulation

### Comply with the requirements of Section 15080 – Process Piping Insulation] [     ].

## Miscellaneous Accessories

### Sheet Metal Plenums:

#### Fabricate from minimum 18 gauge metal of the same material as the ductwork.

#### Brace with frame of same material for rigidity.

#### Line with sound attenuation material where indicated in the Contract Documents.

### Louver and Grille Blank-Off Sections:

#### Fabricate from 20 gauge sheets of the same material as the louver/grille.

#### Line with sound attenuation/insulating material.

#### Shop prime and paint outside face of blank off section with two coats of flat black exterior paint.

### Auxiliary Drain Pans:

#### Dimensions: A minimum 152 mm larger in both dimensions than the equipment it is serving and a minimum of 51 mm high.

#### Construction: 16 gauge galvanized steel with brazed joints. Pans shall be watertight and shall have hemmed edges.

#### Drain Connection:

##### Minimum 1 inch IPS or as shown on the Contract Drawings.

##### Locate at the lowest point of drain pan.

##### In lieu of drain connection, float switch may be installed. The float switch shall shut down air handling equipment upon sensing water.

### Prefabricated Roof Curb:

#### Refer to Section 07700 - Roof Specialties And Accessories.

#### [Prefabricated roof curbs, flashing and counter flashing shall be constructed of [minimum 20 gauge ASTM A90/A90M-13 galvanized steel] [minimum 2.0 mm aluminum].]

#### Internal Insulation:

##### Minimum of 38 mm thick, 16 kg/m3 density, glass fibre insulation.

##### Seams sealed to prevent condensation.

#### Welded or tabbed and riveted construction will be acceptable. Both types of construction shall be manufactured and sealed as required to be watertight and weatherproof.

#### Lower section of roof curb that will be integrated with roofing system shall be constructed to accommodate roofing system provided.

#### Top surface of curb shall have rubber weather seal pad. Provide wooden nailer sections as required for installation.

#### Sheet metal counter flashing shall be provided to accommodate rectangular or round ductwork.

#### Sheet metal screws and rivets shall be stainless steel or coated with corrosion resistant material.

#### Height of roof curb shall be 305 mm, unless otherwise indicated in this Section or on the Contract Drawings.

#### Length and width of roof curb shall be sized by the Contractor for particular application.

#### Manufacturer:

##### Factory fabricated by the equipment manufacturer.

### Accessories Hardware:

#### Instrument Test Holes:

##### Cast metal and material to suit the duct material, including screw cap and gasket and flat mounting gasket.

##### Size to allow insertion of pitot tube and other testing instruments.

##### Provide in a length to suit the duct insulation thickness.

#### Flexible Duct Clamps:

##### Stainless steel band with cadmium plated hex screw to tighten band with worm gear action.

##### Provide in sizes from 75 mm to 450 mm to suit duct size.

#### Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline, and grease.

## Removable Insect Screens

### General

|  |  |
| --- | --- |
| Frame | - extruded aluminium channel, 65 mm x 18 mm  - extruded aluminium angle, 40 x 25 x 3 mm screen frame retainers |
| Screen Retention Frame | - extruded aluminium with rubber retainer gasket |
| Insect Screen | - 18 x 14 mesh, .011 gauge, grade 304 stainless steel |
| Max. Section Size | - 1.5 m x 1.5 m |

### Mounting

|  |  |
| --- | --- |
| Ducting Mounting | - "slide out" screen  - rubber gasket around screen slot in frame  - cast aluminium handle rigidly attached to screen retention frame. 2 handles per screen section |
| Face Mounting | - "lift and remove" screen  - nylon finger pulls, 25 x 30 x 1.5 mm mounted in screen retention frame |

### In locations where removable insect screen is associated with air control dampers, supply the two units as an integrated, factory assembled unit.

### Manufacturer

#### *[Consultant to provide names of three approved products]*

#### Approved Equivalent

## Painting of Ductwork

### Comply with the requirements of Section 09900 – Painting and Protective Coatings.

# EXECUTION

## General Installation

### Miscellaneous:

#### Install sheet metal ductwork and flexible ductwork in accordance with the SMACNA Manuals and standards, NFPA 90A, 2015 Edition, and NFPA 90B, 2015 Edition.

#### Install ductwork using the manufacturer’s recommended adhesives, cement, sealant, and insulation accessories.

#### Align ductwork accurately at connections, within 3.2 mm misalignment tolerance and with internal surfaces smooth.

#### Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be installed, sloped, and connected to louver so that water entering the ductwork system positively drains back to and out of the louver.

### Ductwork Location:

#### Locate ductwork runs vertically and horizontally, unless otherwise indicated in the Contract Documents.

#### Avoid diagonal runs wherever possible.

#### As indicated by diagrams, details, and notations or, if not otherwise indicated in the Contract Documents, run ductwork in the shortest route that does not obstruct usable space or block access for servicing building and equipment.

#### In general, install as close to the bottom of the structure as possible.

#### For ductwork run above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.

#### Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of the building.

#### Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to the bottom of the structure immediately adjacent to obstruction.

### Penetrations:

#### Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls and ceilings.

#### Clearances:

##### For uninsulated ducts, allow 25 mm of clearance between duct and sleeve, except at grilles, registers, and diffusers.

##### For insulated ducts, allow 25 mm of clearance between insulation and sleeve, except at grilles, registers, and diffusers.

#### Closure Collars:

##### A minimum width of 102 mm on each side of walls or floors where sleeves or prepared openings are installed.

##### Fit collars snugly around ducts and insulation.

##### Same gauge and material as duct.

##### Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.

##### Use fasteners with maximum 152 mm centers on collars.

#### Packing: Mineral fibre in spaces between sleeve or opening and duct or duct insulation.

### Concealment:

#### Wherever possible in finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction, or above suspended ceilings.

#### Do not encase horizontal runs in solid partitions, except as specifically shown on the Contract Drawings.

#### Limit clearance to 25 mm where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.

### Coordination with Other Trades:

#### Coordinate duct installation with the installation of accessories, dampers, coil frames, equipment, controls, and other associated Work of the ductwork system.

#### Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on the Contract Drawings.

#### Coordinate ductwork layout with suspended ceiling, lighting and sprinkler head layouts and similar finished Work.

#### Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.

### Shower Room and Toilet Room Exhaust Ductwork:

#### Joints and Seams: Seal watertight.

#### Slope branch ducts downward to grille.

### Fume Hood, Laboratory, and Chlorine Room Exhaust Ductwork:

#### Seal joints and seams with chemical resistant mastic.

#### Rivet butt joints with minimum of eight pop rivets.

## Rectangular Ductwork

### Where possible, install ductwork so that seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.

### If cutting of seams or joints is unavoidable, reinforce the cut portion to its original strength.

## Rectangular Ductwork Fittings

### Use bell mouth or conical tee fittings for round duct takeoffs from rectangular mains.

### Use 45 degree entry fittings conforming to the SMACNA requirements for rectangular takeoffs from rectangular or round mains.

### Make offsets with maximum angle of 45 degrees.

### Use fabricated fittings for changes in directions, changes in size and shape, and connections.

## Rectangular Ductwork Transverse Joints

### Install each run with a minimum number of joints.

### Install couplings tight to the duct wall surface with projections into duct at connections kept to a minimum.

### Mechanical Joint Option:

#### Are comparable to SMACNA class J or H joints when tested with SMACNA procedures

#### The mechanical joints shall be made using [galvanized steel].

#### PVC Cleat:

##### Must comply with NFPA 90A, 2015 Edition and NFPA 90B, 2015 Edition.

##### Operating temperature range: [0 ˚C to 65˚C]

#### Longitudinal joints:

##### Use Pittsburgh lock seam sealed internally with a permanently elastic sealer with the following characteristics:

###### UL listed

###### Minimum tack strength: [13.7] MPa

###### Service temperature: [-17˚C to 93˚C]

#### Conform to the SMACNA Class A sealing requirements.

## Rigid Round Ductwork

### Except where interrupted by fittings, install round ducts in minimum lengths of 3.6 metres.

## Rigid Round Ductwork Joints

### Rigid round ductwork joints shall be in accordance with SMACNA [HVAC Duct Construction Standards, Metal and Flexible] [Round Industrial Duct Construction Standards], unless otherwise specified in the Contract Documents.

### Single and Double Wall Supply and Return System Joints:

#### Less than 900 mm: Slip coupling.

#### Larger than 900 mm: Flanged connector, Van Stone, or welded companion flange type.

### Single and Double Wall Exhaust and Return System Joints:

#### All Sizes, Spiral Seam Duct: Welded flanged connector.

#### All Sizes, Longitudinal Seam Duct: Van Stone flange connector.

## Fiberglass Ductboard

### Grooves shall be modified ship-lap.

### Closure to be Therm Lok or fibreglass fabric mesh and mastic or Approved Equivalent.

## Insulated Flexible Duct

### Installation:

#### Where shown, between branch duct and ceiling diffusers and grilles.

#### Without sags, kinks, sharp offsets, or elbows.

#### As straight and taut as possible.

### Connection: Connect flexible ductwork to round collars, air distribution devices, and terminal units in accordance with flexible duct manufacturer’s recommendations.

### Length:

#### Maximum length of low pressure flexible duct (construction pressure class up to 500 Pa) to be 2,400 mm.

#### Maximum length of medium pressure flexible duct (construction pressure class up to 1,000 Pa) to be 1,200 mm.

### Flexible ductwork shall not pass through wall, floor, or fire resistant rated assembly.

## Ductwork Hangers and Supports

### Install ductwork with support systems in accordance with SMACNA Manuals and standards, unless otherwise noted in the Contract Documents.

### Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.

### Install additional bracing on ductwork as required to prevent ballooning or breathing.

### Support horizontal ducts within 610 mm of each elbow and within 1,220 mm of each branch intersection.

### Support vertical ducts at maximum interval of 4,880 mm and at each floor.

### Upper attachments to structures shall have allowable load not exceeding 25% of failure (proof test) load, but are not limited to specific methods indicated on the Contract Documents. *[Consultant to ensure such details are on the Contract Documents*]

### In new construction, install concrete insert prior to placing concrete.

### [Install seismic restraints on ductwork systems and sway bracing as described in the SMACNA Guidelines for Seismic Restraints of Mechanical Systems.]

## Flexible Connections

### Flexible Collars and Connections:

#### Use between fans and ducts.

#### For round ducts, securely fasten flexible connections by zinc coated steel clinch type draw bands.

#### For rectangular ducts, lock flexible connections to metal collars.

## Dampers

### General:

#### Inspection:

##### Inspect areas to receive dampers.

##### Notify the Consultant of conditions that would adversely affect installation or subsequent utilization of dampers.

##### Do not proceed with installation until unsatisfactory conditions are corrected.

#### Install dampers at locations indicated on the Contract Drawings and in accordance with the manufacturer’s installation instructions.

#### Install square and level.

#### Handle damper using sleeve or frame. Do not lift dampers using blades or jack-shaft.

#### Damper blades and hardware shall operate freely without obstruction.

#### Damper blades and hardware that bind within the frame or which are obstructed by adjacent construction will not be acceptable.

#### When installed, damper frames shall be gasketed or caulked to eliminate leakage between duct and damper frames.

#### Head and sill shall have stops.

#### Suitable for installation in the mounting arrangement shown on the Contract Drawings.

#### Do not compress or stretch damper frame into duct or opening.

### Manual Dampers:

#### Provide balancing dampers for grilles and diffusers in branch duct as near to the main as possible.

#### Add or remove balancing dampers as requested by air balancing firm for necessary control of air.

### Back Draft Dampers:

#### Install dampers square and free from racking with blades running horizontally.

#### Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

### Fire Dampers:

#### At ceiling grille and diffuser fire dampers, provide thermal blankets where required by local authorities.

#### Install 1.5 hour rated, unless otherwise indicated in the Contract Documents, at locations shown and in accordance with SMACNA 1819, Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.

## Access Doors

### [Ceilings:

#### In accordance with the Section 08331 – Overhead Coiling Doors.

#### Install in non-accessible ceilings below each electric duct heater, booster coil, motorized damper, terminal unit, smoke detector, and fire damper.]

### Ductwork: Install access doors in ductwork, in accordance with the manufacturer’s instructions, at each:

#### Duct mounted fire damper.

#### Duct mounted smoke or ionization detector.

#### Electric duct heater.

#### Booster coil.

#### Humidifier.

#### Motorized damper.

#### Sail switch.

#### Turning vane.

#### Volume damper.

#### Automatic damper.

#### Temperature controller.

#### Coil, on both upstream and downstream side.

## Sound Attenuators

### Install where shown on the Drawings and in accordance with applicable SMACNA Manuals and standards and manufacturer’s recommendations.

### Provide dielectric separation where attenuator material differs from connected duct system.

## External Duct Insulation

### Comply with the requirements of Section 15080 – Process Piping Insulation] [     ].

## Miscellaneous Accessories

### Auxiliary Drain Pans:

#### Under equipment for which pans are shown on the Contract Drawings and under all horizontal air handling units located above ceilings and piping located in ceiling space directly above computer facility areas; furnish and install auxiliary drain pans.

#### Route drain lines to nearest floor or hub drain independent of any other drain.

#### Slope drain pans toward drain connection to promote drainage.

#### Louver and Grille Blank off Sections: Attach airtight to the louver or grille and install to allow for easy removal.

### Prefabricated Roof Curb:

#### Refer to Section [07700 - Roof Specialties And Accessories.]

#### [Provide for ductwork roof penetrations and curb mounted roof fans.]

#### Roof curb installation, including flashing and counter-flashing, shall provide watertight weatherproof enclosure.

#### Attach counter-flashing to ductwork via rubber gasketed sheet metal screws.

#### Fill space between counter-flashing and ductwork with silicon based sealant. Sealant shall also be applied at all sheet metal screw locations.

### Inspection Plates and Test Holes:

#### Where required in ductwork for balance measurements.

#### Test holes shall be, airtight and non-corrosive with screw cap and gasket.

#### Extend cap through insulation.

## Duct Sealing

### Seal duct seams and joints as follows:

#### [In accordance with SMACNA requirements.] [As indicated on the Ductwork Schedule, attached as a supplement to this Specification Section.]

#### [In accordance with the following:

##### Pressure Classifications Greater than 750 Pa: Transverse joints, longitudinal seams, and duct penetrations.

##### Pressure Classification between 500 Pa and 750 Pa: Transverse joints and longitudinal seams.

##### Pressure Classification Less than 500 Pa: Transverse joints only.]

#### [In addition to other requirements, provide duct sealing with the following characteristics:

##### Complies with UL 181A and UL 181B

##### Minimum tensile strength of [ ] MPa

##### Service temperature: [-17˚C to 93˚C] MPa

### If no specific duct sealing requirements are specified, requirements of the SMACNA manuals and standards shall govern.

### Seal externally insulated ducts prior to the installation of insulation.

### Provide additional duct sealing as required to comply with the requirements of subsection 3.15 - Ductwork Leakage Testing.

## Fire-stopping

### Comply with the requirements of Section 07840 – Fire-stopping.

## [Painting of Ductwork]

### Comply with the requirements of Section 09900 – Painting and Protective Coatings.

## Ductwork Leakage Testing

### Assemble and install ductwork with maximum leakage limited [as indicated in the Ductwork Schedule attached as a supplement to this Specification Section.] [as follows:

#### [Ductwork leakage testing not required.]

#### [Constant Volume Systems:

##### Supply Ductwork:

###### Operating Pressure: 0 to 500 Pa.

Allowable Leakage: 2 percent of design airflow rate.

###### Operating Pressure: 750 Pa and over.

Allowable Leakage: 1 percent of design airflow rate.

##### Return Ductwork:

###### Operating Pressure: All.

Allowable Leakage: 2 percent of design airflow rate.]

#### [Variable Air Volume System (VAV):

##### Supply Ductwork:

###### Fan to VAV Boxes: 1 percent of design maximum airflow rate.

###### VAV Boxes to Register: 2 percent of design maximum airflow rate.

##### Return Ductwork:

###### Operating Pressure: All.

Allowable Leakage: 2 percent of design maximum airflow rate.]

### Where leakage testing is specified, perform testing in accordance with the requirements of Section 15950 - HVAC Systems Testing, Adjusting, and Balancing.

## Balancing and Testing of Air Systems

### Perform testing in accordance with the requirements of Section 15950 - HVAC Systems Testing, Adjusting, and Balancing.

## Cleaning

### Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing into operation.

### Before installing air outlets, use air handler to blow dry air through entire system at the maximum attainable velocity. Provide temporary air filters for this operation.

## Ductwork Schedule

### Refer to [the Contract Drawings] [the Ductwork Schedule attached as a supplement to this Section].

## Sound Attenuator Schedule

### Refer to [the Contract Drawings] [the Sound Attenuator Schedule attached as a supplement to this Section].

## Supplements

### The supplements listed below, attached following “End of Section”, form part of this Section:

#### [Section 15810-01 - Ductwork Schedule.]

#### [Section 15810-02 - Sound Attenuator Schedule.]*[Consultant to create a Sound Attenuator Schedule and add it to the Contract Documents and specification]*

**END OF SECTION**