

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 05 - Pipework
- .2 Section 23 05 17 - Pipe Welding
- .3 Section 23 05 23 - Valves
- .4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- .5 Section 23 31 13 - Metal Ducts
- .6 Section 23 32 48 - Silencers
- .7 Section 23 37 20 – Louvres
- .8 Section 25 90 01 EMCS Site Requirements, Of Applications & Systems Sequences Operation
- .9 Section 28 31 00 – Fire Detection and Alarm

1.2 REFERENCES

- .1 Definitions:
 - .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.
 - .2 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A-2018, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ANSI/ASHRAE/IESNA 90.1-19, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .4 American Society for Testing and Materials (ASTM).
 - .5 Sheet Metal Air Conditioning Contractors' National Association (SMACNA).
 - .6 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
-

-
- .7 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
 - .8 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN4-S112-10, Fire Test of Fire Damper Assemblies.
 - .3 CAN4-S112.2-07, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .4 ULC-S505-1974, Fusible Links for Fire Protection Service.

Part 2 Products

2.1 DUCTWORK

- .1 Material:
 - .1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A 653/A 653M.
 - .2 Minimum thickness:

| <u>Area</u> | <u>Gage</u> |
|--------------------|-------------|
| Mechanical Room M6 | 18 |
| Bay 3 | 14 |
 - .2 Construction - round and oval.
 - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
 - .2 Transverse joints up to 900mm: slip type with tape and sealants.
 - .3 Transverse joints over 900mm: Vanstone.
 - .4 Fittings:
 - .1 Elbows: smooth radius. Centreline radius: 1.5 x diameter.
 - .2 Branches: conical transition with conical branch at 45 degrees and 45 degrees' elbow.
 - .3 Construction - rectangular:
 - .1 Ducts: to SMACNA.
 - .2 Transverse joints: flanged and gasketed joints, SMACNA seal Class A.
 - .3 Fittings:
 - .1 Elbows: smooth radius; centreline radius 1.5 x width of duct with turning vanes.
 - .2 Branches: with conical branch at 45 degrees and 45 degrees elbow.
 - .4 Fire stopping:
 - .1 50 x 50 x 3 mm retaining angles around duct, on both sides of fire separation.
 - .2 Fire stopping material must not distort duct.
-

2.2 SEAL CLASSIFICATION

- .1 Seal classification: SMACNA Seal Class A, longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.3 SEALANT

- .1 Oil resistant, polymer type flame resistant high velocity duct sealing compound.

2.4 TAPE

- .1 Polyvinyl treated, open weave fibre glass, 50 mm wide.

2.5 HANGERS AND SUPPORTS

- .1 Band hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hangers: steel rods to the following table:

| <u>Duct Size</u> | <u>Angle Size</u> | <u>Rod Size</u> |
|------------------|-------------------|-----------------|
| (mm) | (mm) | (mm) |
| Up to 750 | 25 x 25 x 3 | 6 |
| 751 to 1050 | 40 x 40 x 3 | 6 |
| 1051 to 1500 | 40 x 40 x 3 | 10 |
| 1501 to 2100 | 50 x 50 x 3 | 10 |

- .4 Upper hanger attachments:
 - .1 For steel joist: manufactured joist clamp or steel plate washer.
 - .2 For steel beams: manufactured beam clamps:

2.6 DUCT INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
 - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.
 - .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
 - .4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C 553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C 553.
 - .5 Jackets
 - .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: compatible with insulation.
-

- .3 Aluminum:
 - .1 To ASTM B 209 with moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Stucco embossed.
 - .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.
 - .5 Metal jacket banding and mechanical seals: stainless

2.7 AIR DUCT ACCESSORIES

- .1 Insulated flexible duct connections
 - .1 Frame: galvanized sheet metal frame 100 mm thick with fabric clenched by means of double locked seams.
 - .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of
 - .2 1.3 kg/m².
 - .3 25mm thermal insulation.
 - .3 Grounding:
 - .1 #6 AWG stranded copper braided wire to bridge ducts on either side of flexible connection.
 - .2 Access doors in ducts
 - .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
 - .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
 - .3 Gaskets: neoprene.
 - .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .5 Size:
 - .1 450 x 450 mm for person size entry.
 - .2 450 x 450 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .4 As indicated.
-

- .6 Locations:
 - .1 At fire dampers.
 - .2 At control dampers.
 - .3 At Devices requiring maintenance.
 - .4 At locations Required by code.
 - .5 At Reheat coils.
 - .6 Elsewhere as indicated.
 - .3 Turning vanes
 - .1 Factory or shop fabricated, to recommendations of SMACNA.
 - .4 Instrument test ports
 - .1 1.6 mm thick steel zinc plated after manufacture.
 - .2 Cam lock handles with neoprene expansion plug and handle chain.
 - .3 28 mm minimum inside diameter. Length to suit insulation thickness.
 - .4 Neoprene mounting gasket.
 - 2.8 DAMPERS – BALANCING**
 - .1 Splitter dampers
 - .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
 - .2 Double thickness construction.
 - .3 Control rod with locking device and position indicator.
 - .4 Rod configuration to prevent end from entering duct.
 - .5 Pivot: piano hinge.
 - .6 Folded leading edge.
 - .2 Single blade dampers
 - .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
 - .2 Size and configuration to recommendations of SMACNA, except maximum height 100mm.
 - .3 Locking quadrant with shaft extension to accommodate insulation thickness.
 - .4 Inside and outside nylon end bearings.
 - .5 Channel frame of same material as adjacent duct, complete with angle stop.
 - .3 Multi-bladed dampers
 - .1 Factory manufactured of material compatible with duct.
 - .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
 - .3 Maximum blade height: 100 mm.
 - .4 Bearings: self-lubricating nylon.
 - .5 Linkage: shaft extension with locking quadrant.
-

- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage: 0.07 % at 1000 Pa.

2.9 DAMPERS-OPERATING

- .1 Operating dampers shall be multi-leaf type.
- .2 Dampers for the purpose of on/off operation shall be parallel blade arrangement actuation.
- .3 Dampers for the purpose of air flow control (throttling) shall be of opposed blade actuation arrangement.
- .4 Dampers shall be of extruded aluminum type blade, interlocking blades, vinyl seals, spring stainless steel side seals and structurally formed extruded aluminum frame.
- .5 Pressure fit self-lubricated bronze bearings
- .6 Linkage shall be plated steel tie rods, brass pivots with control rod and brackets.
- .7 Performance shall be leakage less than 2% of rated air flow at 250kPa differential pressure across damper.
- .8 Provide insulated aluminum dampers where exposed to the outside conditions such as outdoor air damper and exhaust air dampers.
 - .1 Frame shall be insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Frame shall be thermally broken.
 - .3 Blades shall be aluminum with internal hollows insulated with polyurethane foam, RSI 0.88.
- .9 Damper actuator shall be Belimo, 24V c/w spring return and end switch.

2.10 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B or C, listed and bear label of ULC, meet requirements of Fire Commissioner of Canada (FCC) and ANSI/NFPA 90A. Fire damper assemblies fire tested in accordance with CAN4-S112.
 - .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
 - .3 Top hinged: offset single damper, round or square; interlocking type; sized to maintain full duct cross section.
 - .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
 - .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
 - .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair
-

-
- .7 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
 - .8 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with ASHRAE and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate band hangers 100 mm beyond insulated duct.
 - .2 Ensure diffuser is fully seated.
 - .3 Support risers in accordance with SMACNA.
 - .4 Install breakaway joints in ductwork on sides of fire separation.
 - .5 Ensure installation of firestopping does not distort duct.

3.2 HANGERS AND STIFFENERS

- .1 Band hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Minimum hanger spacing as follows:

| Duct Size (mm) | Spacing (mm) |
|-------------------|-----------------|
| up to 1500 | 1200 |
| 1501 and over | 2000 |

- .4 Minimum stiffener spacing as follows:

| Duct Size (mm) | Spacing (mm) |
|-------------------|-----------------|
| up to 750 | 1200 |
| 751 to 1,650 | 1500 |

3.3 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA and manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.4 DUCT INSULATION

- .1 Install in accordance with TIAC National Standards.
 - .2 Apply materials in accordance with manufacturer's instructions and as indicated.
 - .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
-

- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 200 mm on centre in horizontal and vertical directions, minimum 2 rows each side.
- .7 Ductwork insulation schedule
 - .1 Insulation types, thicknesses and jacketing: Conform to following table:

| (1) Material Type | (2) TIAC Code Retarder | (3) Vapour | (4) Thickness (mm) | (5) Jacket |
|--|---------------------------|---------------|-----------------------|---------------|
| Exposed Rectangular Supply Air Ducts | None | None | None | None |
| Exposed Return Ducts in Space Being Served | None | None | None | None |
| Exposed Outdoor Air Ducts | C-1 | Special | 50 | Canvas |
| Exposed Relief Air Ducts | C-1 | Special | 50 | Canvas |
| Acoustically-Lined Ducts | None | None | None | |

3.5 AIR DUCT ACCESSORIES

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units.
 - .2 Length of connection: 100mm.
 - .3 Grounding:
 - .1 #6 AWG stranded copper braided wire to bridge ducts on either side of flexible connection.
 - .4 Minimum distance between metal parts when system in operation: 75 mm.
 - .5 Install in accordance with recommendations of SMACNA.
 - .6 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Instrument Test Ports:
 - .1 General:

- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Locate to permit easy manipulation of instruments.
- .3 Install insulation port extensions as required.
- .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to air handling unit in Mechanical Room M6.
 - .2 Main and sub-main ducts.
 - .2 For temperature readings:
 - .1 At outside air intakes.

3.6 DAMPERS – BALANCING

- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .3 Runouts to registers and diffusers: install splitter dampers located at each runout serving single register or diffuser.
- .4 Main duct trunks: install balancing dampers at all main trunks of ductwork.
- .5 Dampers: vibration free.
- .6 Corrections and adjustments made by Division 23 to achieve indicated volume of airflow.
- .7 Ensure damper operators are observable and accessible.

3.7 DAMPERS – FIRE

- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation. Co-ordinate with installer of fire stopping.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

3.8 CONNECTION TO DIFFUSERS AND REGISTERS

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head, cadmium plated screws in countersunk holes where fastenings are visible to flanged ductwork with screws.
- .3 Provide concealed safety chain on each grille, register and diffuser
- .4 Coordinate spacing for screws with diffuser and register shop drawings.