
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.
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- .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:

Area	Gage
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.
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- .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.

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- .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.
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- .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.