

Part 1 General

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge where indicated separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS 3/4 ball valve, with hose end male thread, cap and chain.

3.4 AUTOMATIC DRAIN VALVE

- .1 Install automatic drain valve at new receiver tank.
- .2 Install isolating valve at each automatic drain valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: Isolating flanges.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Slope piping, except where indicated, in direction of flow for positive condensate drainage.
- .6 Ream pipes, remove scale and other foreign material before assembly.
- .7 Use eccentric reducers at pipe size changes to ensure positive drainage.
- .8 Valves:
 - .1 Install in accessible locations;
 - .2 Remove interior parts before soldering;
 - .3 Install with stems above horizontal position unless otherwise indicated;
 - .4 Valves accessible for maintenance without removing adjacent piping; and,
 - .5 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.
- .9 Check Valves:
 - .1 Install check valves as indicated.

3.7 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by City.
- .2 Request written approval ten (10) days minimum, prior to commencement of work.

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- .3 Be responsible for damage to existing plant by this work.
 - .4 Ensure daily clean-up of existing areas.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
 - .1 ANSI/ASME B31.9, Building Service Piping; and,
 - .2 ANSI/ASME Boiler and Pressure Vessel Code:
 - .1 Section V: Nondestructive Examination
 - .2 Section IX: Welding and Brazing Qualifications
- .2 American Welding Society (AWS)
 - .1 AWS C1.1, Recommended Practices for Resistance Welding;
 - .2 AWS Z49.1, Safety Welding, Cutting and Allied Process; and,
 - .3 AWS W1, Welding Inspection Handbook.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum;
 - .2 CSA W48 series, Filler Metals and Allied Materials for Metal Arc Welding;
 - .3 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code;
 - .4 CSA-W117.2, Safety in Welding, Cutting and Allied Processes;
 - .5 CSA W178.1, Certification of Welding Inspection Organizations; and,
 - .6 CSA W178.2, Certification of Welding Inspectors.

1.2 QUALIFICATIONS

- .1 Welders
 - .1 Welding qualifications in accordance with CSA B51;
 - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction;
 - .3 Furnish welder's qualifications to Contract Administrator ;
 - .4 Each welder to possess identification symbol issued by authority having jurisdiction; and,
 - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors
 - .1 Inspectors qualified to CSA W178.2.

1.3 QUALITY ASSURANCE

- .1 Registration of welding procedures in accordance with CSA B51.
- .2 Copy of welding procedures available for inspection.
- .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

Part 2 Products

2.1 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 WORKMANSHIP

- .1 Welding: in accordance with ANSI/ASME B31.9, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

3.2 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
 - .1 Where used, fit to minimize gaps between ring and pipe bore; and,
 - .2 Do not install at orifice flanges.
- .3 Fittings:
 - .1 NPS 2 and smaller: install welding type sockets; and,
 - .2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Contract Administrator before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Contract Administrator.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.4 SPECIALIST EXAMINATIONS AND TESTS

- .1 General
 - .1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and reviewed by Contract Administrator;
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction; and,
 - .3 Inspect and test 10% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.
- .2 Hydrostatically test welds to requirements of ANSI/ASME B31.9 and as specified herein.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

- .4 Failure of visual examinations:
 - .1 Upon failure of welds by visual examination, perform additional testing as directed by Contract Administrator of total of up to 10% of welds, selected at random by Contract Administrator by particle tests.

3.5 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.9 and ANSI/ASME Boiler and Pressure Vessels Code.
- .2 In addition, compressed air systems:
 - .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe;
 - .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe;
 - .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface;
 - .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm;
 - .5 Repair cracks and defects in excess of 0.8 mm in depth; and,
 - .6 Repair defects whose depth cannot be determined accurately on basis of visual examination or particle tests.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.7 WELDING VENTILATION

- .1 Contractor to provide temporary welding extraction system vented outdoors away from operable windows, doors or ventilation air intake openings.
- .2 Space in which the welding is take place is to be maintained at a negative pressure in relation to the remaining facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.9, Building Service Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated;
 - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength; and,
 - .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture;
 - .2 ANSI/MSS SP69, Pipe Hangers and Supports - Selection and Application; and,
 - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

1.2 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies;
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.9 or MSS SP58;
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure;
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment; and,
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports

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- .2 Connections to equipment and structure
 - .3 Structural assemblies
 - .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements; and,
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.9 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.
- .4 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies: fabricated from material complying with ASTM A-36.
- .5 Hanger rods: threaded rod material to MSS SP58:
 - .1 Ensure that hanger rods are subject to tensile loading only; and,
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.

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- .6 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel black; and,
 - .2 Oversize pipe hangers and supports.
 - .7 Adjustable clevis: material to MSS SP69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

2.3 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

2.4 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 GENERAL

- .1 Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

3.3 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at compressors, and as indicated.

3.4 HANGER SPACING

Maximum Pipe Size: NPS	Maximum Spacing Steel
up to 1-1/4	2.1 m
1-1/2	2.7 m
2	3.0 m
2-1/2	3.3 m
3	3.6 m
4	4.2 m

3.5 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 For pipe attachment to steel joints support piping from upper joist chord only.

3.6 HORIZONTAL MOVEMENT

- .1 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.7 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions; and,
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance; and,
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-[01], SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 The National Energy Code of Canada for Buildings – 2011.
- .3 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric);
 - .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation;
 - .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation;
 - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement;
 - .5 ASTM C547, Specification for Mineral Fiber Pipe Insulation;
 - .6 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications;
 - .7 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation;
 - .8 ASTM C795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel; and,
 - .9 ASTM C921, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .4 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .6 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies; and,
 - .2 CAN/ULC-S70, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces;
 - .2 "EXPOSED" - will mean "not concealed" as defined herein; and,

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- .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork; and,
 - .2 CRF: Code Rectangular Finish.

1.3 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least three (3) years successful experience in this size and type of project, qualified to standards.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to Site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25; and,
 - .2 Maximum smoke developed rating: 50.

2.2 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 C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, 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 C553 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 C553;
 - .2 Jacket: to CGSB 51-GP-52Ma; and,
 - .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum:
 - .1 To ASTM B209 with and without moisture barrier as scheduled in PART 3 of this section;
 - .2 Thickness: 0.50 mm sheet;
 - .3 Finish: Smooth;
 - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel:
 - .1 Stainless steel:
 - .1 Type: 304
 - .2 Thickness: 0.25 mm sheet
 - .3 Finish: Smooth
 - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation; and,
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m²
- .6 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting.
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

- .11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation.
- .12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install to the more stringent of the National Energy Code of Canada for Buildings.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served			none
Outside air ducts to mixing plenum	C-1	yes	25

	TIAC Code	Vapour Retarder	Thickness (mm)
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvers	C-1	no	25
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	none		

.2 HERE Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct:

.1 Finishes: Conform to following table:

	TIAC Code	TIAC Code
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

END OF SECTION

Part 1 General

1.1 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.2 INDUSTRIAL QUALITY COMPRESSED AIR SYSTEMS

- .1 Commissioning Agency: installing Contractor.
- .2 Design Criteria, Design Intents: refer to Performance Verification (PV) Report Forms.
- .3 Commissioning Procedures:
 - .1 Air Compressor: refer to equipment schedule on Drawing M3;
 - .2 Check operation of automatic drain valves;
 - .3 Bleed off measured flow rate of compressed air from receiver;
 - .4 Measure cumulative length of time that air compressor operates to recover pressure. Carry out test over extended period of time;
 - .5 Test compressor unloading systems at stages of operation. This may be performed by repeating above test at several bleed-off rates;
 - .6 Refrigerated air drier: perform similar checks and tests as specified for air compressor. Measure cooling air flow rate, pressure, entering and leaving ambient and compressed air temperatures; and,
 - .7 Water-cooled after-coolers: measure water flow rate, EWT, LWT, compressed air temperature, pressure drops.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 CLEANING SOLUTIONS

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures: and,
 - .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip;
 - .2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled; and,
 - .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association (NFPA).
 - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems;
 - .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; and,
 - .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible;
 - .2 SMACNA HVAC Air Duct Leakage Test Manual; and,
 - .3 IAQ Guideline for Occupied Buildings Under Construction.
- .7 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section for the following:
 - .1 Sealants;
 - .2 Tape; and,
 - .3 Proprietary Joints.

1.4 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
- .3 Indoor Air Quality (IAQ) Management Plan.
 - .1 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on-Site stored or installed absorptive material from moisture damage.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed
- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape;
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant;
 - .3 Class C: transverse joints and connections made air tight with sealant. Longitudinal seams unsealed; and,
 - .4 Unsealed seams and joints.

2.2 SEALANT

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: standard radius Centreline radius: 1.5 times width of duct; and,
 - .2 Round: smooth radius five (5) -piece. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes: and,
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45 degrees entry on branch;
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection;
 - .3 Provide volume control damper in branch duct near connection to main duct; and,
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle; and,
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.

2.6 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.7 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment:
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct:
 - .1 Maximum size duct supported by strap hanger: 500
 - .2 Hanger configuration: to SMACNA;
 - .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA;
 - .4 SPEC NOTE: Ensure upper hanger attachments are compatible with structure; and,
 - .5 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts
 - .2 For steel joist: manufactured joist clamp
 - .3 For steel beams: manufactured beam clamps

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures;
 - .2 Section 01 45 00 - Quality Control; and,
 - .3 Section 01 78 10 - Closeout Submittal.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
 - .1 Flexible connections
 - .2 Duct access doors
 - .3 Turning vanes
 - .4 Instrument test ports
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties:
 - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

Part 2	Products
2.1	GENERAL
.1	Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.
2.2	FLEXIBLE CONNECTIONS
.1	Frame: galvanized sheet metal frame 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 1.3kg/m ² .
2.3	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; and,
.6	300 x 300 mm glass viewing panels.
2.4	TURNING VANES
.1	Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA and as indicated.
2.5	INSTRUMENT TEST
.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.
2.6	SPIN-IN COLLARS
.1	Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
.2	Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans
 - .2 Inlets and outlets of exhaust and return air fans
 - .3 As indicated
 - .2 Length of connection: 100 mm;;
 - .3 Minimum distance between metal parts when system in operation: 75 mm;
 - .4 Install in accordance with recommendations of SMACNA; and,
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment
 - .2 Ensure slack material in flexible connection
- .2 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 As indicated
 - .2 Locations:
 - .1 Control dampers
 - .2 Devices requiring maintenance
 - .3 Required by code
 - .4 Elsewhere as indicated
- .3 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; and,
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters
 - .2 Inlets and outlets of other fan systems
 - .3 Main and sub-main ducts
 - .4 And as indicated

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- .2 For temperature readings:
 - .1 At outside air intakes
 - .2 At inlet and outlet of coils
 - .3 Downstream of junctions of two (2) converging air streams of different temperatures
 - .4 And as indicated
 - .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract;
 - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic Site visits for inspection of product installation in accordance with manufacturer's instructions; and,
 - .3 Schedule Site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins
 - .2 Upon completion of the Work, after cleaning is carried out

3.4 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION