

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 74 00 – Cleaning and Process Waste.
- .2 Section 07 84 00 - Firestopping.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 00 – Cleaning and Process Waste.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by City.

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, 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 separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

- .1 Install manual air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air 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 jointed with Teflon tape.
- .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 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

- .7 Install concealed pipe work to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 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.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use gate ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

- .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
- .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
- .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 00 – Cleaning and Process Waste supplemented as specified.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Contract Administrator hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Contract Administrator.
- .6 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

- .7 Insulate or conceal work only after approval and certification of tests by Contract Administrator.

3.12 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Contract Administrator.
- .2 Request written approval 10 days minimum, prior to commencement of work.
- .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 SUMMARY

- .1 Section Includes:
 - .1 Electrical motors, drives and guards for mechanical equipment and systems.
 - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)

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 datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .3 Closeout Submittals
 - .1 Provide maintenance data for motors, drives and guards 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.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 00 - Cleaning.

Part 2 Products

2.1 GENERAL

- .1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W (1/2 HP) : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 230/600 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Contract Administrator for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 10 - Closeout Submittals.

2.5 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
- .3 38 mm dia holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.-
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

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 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - 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 SECTION INCLUDES

- .1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 – Cleaning and Waste Processing.
- .3 Section 23 05 54 - Mechanical Identification.

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
- .2 ASME B40.100-01, Pressure Gauges and Gauge Attachments.
- .3 ASME B40.200-01, Thermometers, Direct Reading and Remote Reading.
- .4 Canadian General Standards Board (CGSB).
- .5 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .6 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
- .4 Thermometers.
- .5 Pressure gauges.
- .6 Stop cocks.
- .7 Syphons.
- .8 Wells.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Collect, separate and place in designated containers for reuse and recycling paper, plastic polystyrene, corrugated cardboard, etc in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.
- .4 Place materials defined as hazardous or toxic waste in designated containers.

- .5 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.
- .2 Ranges: as required.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB14.4

Part 3 Execution

3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated.
- .3 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in following locations:
- .2 In locations as indicated.
- .3 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .4 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

- .1 Install engraved lamicoïd nameplates as specified in Section 23 05 54 - Mechanical Identification, identifying medium.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-04, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125-1996(R2001), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-04a, 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 SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

1.3 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 B31.1 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.

- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 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 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

- .1 Rod: 9 mm UL listed.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed .
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies
 - .2 Steel brackets.
- .6 Hanger rods: threaded rod material to MSS SP58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .7 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel [black][galvanized].
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.5 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.6 EQUIPMENT SUPPORTS

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

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.8 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel.

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 INSTALLATION

- .1 Install in accordance with:
 - .1 manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 vertical movement of pipework is 13 mm or more,
 - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: to authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .5 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

- .6 Pipework greater than NPS 12: to MSS SP69.

3.4 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.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .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.

3.7 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

- .2 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.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-[2002], Standard for the Installation of Sprinkler Systems.
- .3 National Building Code of Canada (NBC) - [1995]

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .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.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Provide separate shop drawings for each isolated system complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
 - .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Colour code springs.

2.3 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.
- .6 Performance: as indicated.

2.4 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.5 SEISMIC CONTROL MEASURES

- .1 General:
 - .1 Following systems and/or equipment to remain operational during and after earthquakes:
 - .1 Fan F-1 smoke exhaust system.
 - .2 Seismic control systems to work in every direction.
 - .3 Fasteners and attachment points to resist same maximum load as seismic restraint.
 - .4 Drilled or power driven anchors and fasteners not permitted.
 - .5 No equipment, equipment supports or mounts to fail before failure of structure.
 - .6 Supports of cast iron or threaded pipe not permitted.
 - .7 Seismic control measures not to interfere with integrity of firestopping.
 - .2 Static equipment:
 - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Suspended equipment:
 - .1 Use one or more of following methods depending upon site conditions or as indicated:
 - .1 Install tight to structure.
 - .2 Cross brace in every direction.
 - .3 Brace back to structure.
 - .4 Cable restraint system.
 - .3 Seismic restraints:
 - .1 Cushioning action gentle and steady.
 - .2 Never reach metal-like stiffness.
 - .3 Vibration isolated equipment:
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
 - .3 As indicated.
 - .4 Piping systems:
 - .1 Fire protection systems: to NFPA 13.
 - .2 Piping systems: hangers longer than 300 mm; brace at each hanger.
 - .3 Compatible with requirements for anchoring and guiding of piping systems.
 - .5 Bracing methods:

- .1 Approved by Departmental Representative.
- .2 Structural angles or channels.
- .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

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 INSTALLATION

- .1 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
 - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Upon completion of installation.

- .3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
- .4 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification:
 - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC system[s] after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .2 Take vibration measurements for equipment as indicated.
 - .3 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
 - .4 Submit complete report of test results.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .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 requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

1.3 SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

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.
- .2 Waste Management and Disposal:
 - .1 Construction Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1		10 x 50	1	3
2		13 x 75	1	5
3		13 x 75	2	3
4		20 x 100	1	8
5		20 x 100	2	5
6		20 x 200	1	8
7		25 x 125	1	12
8		25 x 125	2	8
9		35 x 200	1	20
 - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.3 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1 authority having jurisdiction.
 - .2 Propane gas: to CSA/CGA B149.1 authority having jurisdiction.
 - .3 Sprinklers: to NFPA 13.
 - .4 Standpipe and hose systems: to NFPA 14.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .3 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .4 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .5 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .6 Colours and Legends:
 - .1 Where not listed, obtain direction from City’s Representative and Contract Administrator.
 - .2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE
 - .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
City water	Green	CITY WATER
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.5 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: black, or co-ordinated with base colour to ensure strong contrast.

2.6 VALVES, CONTROLLERS

- .1 Lamacoid tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE

- .1 Identification in English.

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 TIMING

- .1 Provide identification only after interior painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.

- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in equipment rooms, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Number valves in each system consecutively.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .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 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Contract Administrator within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB including repairs, re-testing into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Contract Administrator in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Contract Administrator for verification of TAB reports.

1.9 START OF TAB

- .1 Notify City's Representative, Contract Administrator 7 days prior to start of TAB.

- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weather stripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5 %, minus 5 %.
 - .2 Hydronic systems: plus or minus 10 %.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of City's Representative Contract Administrator, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .2 Submit two copies of tab report to Contract Administrator for initial review. Do changes and comments thru resubmit. 6 copies of TAB Report to Contract Administrator for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by City's Representative Contract Administrator.
- .2 Number and location of verified results as directed by Contract Administrator.
- .3 Pay costs to repeat TAB as required to satisfaction of Contract Administrator.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Contract Administrator, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Contract Administrator.

1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of AABC.

- .2 Do TAB of exhaust, supply air and return air systems, equipment, components, controls specified Division 23.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC.
- .4 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .5 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.
- .2 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.
 - .2 TAB procedures:
- .3 Zone pressure differences:
 - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combination of normal operating modes.
- .4 Smoke management systems:
 - .1 Test for proper operation of all smoke and fire dampers, sensors, detectors, installed as component parts of air systems specified Division 23.

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 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.

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 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins.

- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: leakage 2 %.
 - .2 VAV box and duct on downstream side of VAV box: leakage 2 %.
 - .3 Large low pressure duct systems up to 500 Pa: leakage 2 %.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

3.5 CLEANING

- .1 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 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 – Cleaning and Waste Processing.

1.2 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 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M-02, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation Polystyrene, Boards and Pipe Covering.

1.3 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.
- .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.6 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least 5 years successful experience in this size and type of project, qualified to standards.

1.7 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.
 - .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.
 - .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.

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.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, reinforced, 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 galvanized steel hexagonal wire mesh stitched on one face of insulation one face of insulation with expanded metal lath on other face.
- .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 in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers 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:
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm o/c in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

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

	<u>TIAC Code</u>	<u>Vapour Retarder</u>	<u>Thickness (mm)</u>
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Combustion cold air to condensing boilers	C-2	yes	50
Rectangular warm air ducts			none
Round warm air ducts			
Supply, return and exhaust ducts exposed in space being served			none
Outside air ducts to mixing plenum	C-1	yes	25
Combustion air ductwork	C-1	yes	25

	<u>TIAC Code</u>	<u>Vapour Retarder</u>	<u>Thickness (mm)</u>
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	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:

	<u>TIAC Code</u>	<u>Round</u>
	<u>Rectangular</u>	
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 SUMMARY

- .1 Section Includes:
 - .1 Pneumatic control components for typical commercial building specification.

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.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Provide diagrams showing normal positions, model numbers, air piping and wiring layouts.
 - .3 Provide technical literature on components.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Processing.

Part 2 Products

2.1 IDENTIFICATION

- .1 Provide in accordance with Section 23 05 54 - Mechanical Identification.

2.2 CONTROL AIR TUBING

- .1 Plastic: flame retardant PVC tubing with minimum burst gauge pressure of 1.4 MPa at 80 degrees C.
- .2 Copper: type L complete with flared fittings.

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 INSTALLATION

- .1 Identify and code pneumatic tubing at every branch and at each piece of equipment and components.
- .2 Use copper tubing with flared fittings in following locations:
 - .1 Inaccessible areas.
 - .2 Where single lines travel from tube tray to instruments.
 - .3 Areas of heat above 80 degrees C.
 - .4 Mechanical rooms.
 - .5 Rooms where piping subject to damage.
 - .6 Adjacent to heating pipes passing through common sleeve.
 - .7 Where air pressures above 200 kPa.
 - .8 Where codes will not permit use of PVC.
 - .9 In fire rated walls and ceilings.
- .3 Follow building lines. Do not cover with insulation. Install drip legs and drains at low points.

3.3 FIELD QUALITY CONTROL

- .1 Start-Up and Adjustment:
 - .1 Upon completion of installation, test, adjust and regulate controls or safety equipment provided under this Section.
 - .2 Adjust and place in operating condition.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .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.
 - .2 Section 07 84 00 - Firestopping.
 - .3 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

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-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 96-01, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures .

1.4 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 gaskets sealant. Longitudinal seams unsealed.
- .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 short radius with single thickness turning vanes
Centreline radius: 1.5 times width of duct.
- .2 Round: smooth radius five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

- .1 To 400 mm: with single thickness turning vanes.
- .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.
- .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Full short radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.
- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

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

2.8 BLACK STEEL

- .1 To ASTM A635/A635M.
- .2 Thickness: 1.2 mm or as indicated.
- .3 Fabrication: ducts and fittings to ASHRAE SMACNA.
- .4 Reinforcement: as indicated.
- .5 Joints: continuous weld.

2.9 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 ASHRAE and SMACNA.
 - .3 Hangers: black galvanized steel angle with black galvanized steel rods to ASHRAE and SMACNA following table :

Duct Size (mm)	Angle Size (mm)	Rod Size (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
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 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 NFPA 90A NFPA 90B ASHRAE, SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated .
- .3 Support risers in accordance with SMACNA as indicated .
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions .
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining .

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 and as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Dishwasher exhaust.
 - .2 Fresh air intake.

- .3 Minimum 3000 mm from duct mounted humidifier in all directions.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Solder joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards hoods served.
 - .1 Slope header ducts down toward risers.
- .4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and discharging to open funnel drain or as indicated.

3.4 SEALING AND TAPING

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

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 78 10 - Closeout Submittals.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

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 Instructions: submit manufacturer's installation instructions.
- .4 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 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 1.3 kg/m².

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.
 - .2 301 to 450 mm: four sash locks.
 - .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.

2.4 TURNING VANES

- .1 Factory or shop fabricated single thickness double 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.
 - .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:
 - .1 600 x 600 mm for person size entry.
 - .2 600 x 600 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .4 As indicated.
 - .5 Keep doors out of residents rooms.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Manual dampers and elsewhere as indicated.
 - .7 Variable air volume valves.
- .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.
 - .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.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Contract Administrator .
 - .3 At inlet and outlet of coils.

- .4 Downstream of junctions of two converging air streams of different temperatures.
- .5 And as indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

- .1 Perform cleaning operations as specified in Section 01 74 00 and in accordance with manufacturer's recommendations.
- .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 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

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.

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.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 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 100 mm.
- .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.

2.3 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: pin in bronze bushings self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

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 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems. Keep dampers out of residence rooms.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ductwork take offs. Keep dampers out of residence rooms.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible. Keep dampers out of residence rooms.
- .7 Corrections and adjustments conducted by Contract Administrator.

3.3 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Test to demonstrate that the system is functioning as specified.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning and Waste Processing.
- .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 Operating dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

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 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 .
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

- .1 Opposed parallel blade type as indicated.
- .2 Structurally formed steel Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Performance:

- .1 Leakage: in closed position less than 2% of rated air flow at 1000 Pa differential across damper.
- .2 Pressure drop: at full open position less than Pa differential across damper at m/s.
- .6 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.2 BACK DRAFT DAMPERS

- .1 Automatic gravity operated, multi single leaf, aluminum steel construction with nylon bearings, centre pivoted spring assisted or counterweighted, as indicated.

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 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories .
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - 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 Fire and smoke dampers.

1.2 REFERENCES

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

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 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Operators.
 - .4 Fusible links.
 - .5 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals .

1.4 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals .

- .2 Provide following:
 - .1 6 fusible links of each type.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type A B C, listed and bear label of ULC UL, meet requirements of provincial fire authority and ANSI/NFPA 90A authorities having jurisdiction. 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; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section as indicated .
- .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 damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 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.
- .10 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 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 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories or assure access door provided on fire/smoke damper is accessible. Review at shop drawing stage.
- .5 Co-ordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - 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 flexible ductwork, joints and accessories.

.2 Related Sections:

.1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 National Fire Protection Association (NFPA).

.1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-02, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 (Addendum No.1, November 1997).

.2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

.4 Underwriters' Laboratories Inc. (UL).

.1 UL 181-96, Standard for Factory-Made Air Ducts and Air Connectors.

.5 Underwriters' Laboratories of Canada (ULC).

.1 CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures .

.2 Samples: submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00 - Submittal Procedures .

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 GENERAL

.1 Factory fabricated to CAN/ULC-S110.

- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - UNINSULATED

- .1 Type 3 : non-collapsible, coated mineral base fabric type, mechanically bonded to, and helically supported by, external steel wire, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.3 NON-METALLIC - INSULATED

- .1 Type 4 : non-collapsible, coated mineral base fabric type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl jacket, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Thermal loss/gain: W/m^2 . degrees C mean.

Part 3 Execution

3.1 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110 UL-181 NFPA 90A NFPA 90B SMACNA .

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Fans, motors, accessories and hardware for commercial use.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

- .1 AMCA Publication 99-2003, Standards Handbook.
- .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

- .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
- .2 Capacity: flow rate, total static pressure, bhp W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal .
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter .

1.4 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 Shop Drawings:

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures .
- .3 Provide :
 - .1 Fan performance curves showing point of operation, BHP kW and efficiency.
 - .2 Sound rating data at point of operation.
- .4 Indicate:
 - .1 Motors, sheaves, bearings, shaft details .
 - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals .
 - .1 Spare parts to include:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.6 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 For use with variable speed controllers.
 - .3 Sizes as indicated.
 - .4 Two speed with two windings and speeds of approximately as indicated.

- .5 Two speed with split winding, constant horsepower constant or variable torque and speeds of r/min.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan inlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment . inlet outlet dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .6 Vibration isolation: to Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment.
- .7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 CENTRIFUGAL FANS

- .1 Fan wheels:
 - .1 Welded steel aluminum construction.
 - .2 Maximum operating speed of centrifugal fans not more than 50 % of first critical speed.
 - .3 Air foil forward curved backward inclined blades, as indicated.
- .2 Bearings: heavy duty split pillow-block flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.
- .3 Shaft seals on exhaust fans:
 - .1 Single disc seals.
- .4 Housings:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, cast iron, steel, aluminum, for smaller wheels, braced, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
 - .3 Provide bolted latched airtight access doors with handles.

2.3 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)

- .1 Casings: welded steel with welded motor support, hinged or bolted access plates, streamlined inlet cone and discharge bell sections and integral silencer casing external.
- .2 Blade material: steel aluminum. Hub material: steel aluminum.
- .3 Supports:

- .1 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.
- .4 Bearings: ball or roller with extension tubes to outside of casing.
- .5 Belt drive:
 - .1 Drive fixed adjustable blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.
 - .2 Adjust blades for varying range of volume and pressure. Hubs to facilitate indexing of blade angle. Provide manual automatic adjustment stops to avoid overloading motor.

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 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment , flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand acceleration and velocity forces as specified .

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - 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 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

1.2 SYSTEM DESCRIPTION

.1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

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 Samples:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples are required for following:
 - .1 Exhaust, return air and supply diffuser for residence room.

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.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5 MAINTENANCE

.1 Extra Materials:

- .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

Part 2 Products

2.1 GENERAL

- .1 To meet capacity acceptable noise levels.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners or vandal proof screws.
 - .4 Counter sunk screw holes.
- .3 Concealed manual volume control damper operators.
- .4 Colour: Final approval by Contract Administrator at Shop Drawing time.
- .5 Refer to Schedules and Drawings.

2.2 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 SUPPLY GRILLES AND REGISTERS

- .1 Refer to schedule.

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 Refer to schedule.

2.5 DIFFUSERS

- .1 Refer to schedule.

2.6 LINEAR GRILLES

- .1 Refer to schedule.

2.7 SECURITY GRILLES

- .1 Refer to schedule.

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 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head oval head vandal proof screws in countersunk holes where fastenings are visible.
- .3 Grilles and diffusers to be installed as security type installation where noted in schedule.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION