

PART 1      GENERAL

1.1      RELATED SECTIONS

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 02 41 99 - Demolition for Minor Works.
- .3      Section 01 78 00 - Closeout Submittals.

1.2      SUBMITTALS

- .1      Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Shop drawings; submit drawings stamped and signed for approval by Owner's Representative.
- .3      Shop drawings to show:
  - .1      Mounting arrangements.
  - .2      Operating and maintenance clearances.
- .4      Shop drawings and product data accompanied by:
  - .1      Detailed drawings of bases, supports, and anchor bolts.
  - .2      Acoustical sound power data, where applicable.
  - .3      Points of operation on performance curves.
  - .4      Manufacturer to certify current model production.
  - .5      Certification of compliance to applicable codes.
- .5      In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6      Closeout Submittals:
  - .1      Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2      Operation and maintenance manual approved by, and final copies deposited with, Owner's Representative before final inspection.
  - .3      Operation data to include:
    - .1      Control schematics for systems including environmental controls.
    - .2      Description of systems and their controls.

- .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
- .4 Operation instruction for systems and component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Colour coding chart.
- .4 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Owner's Representative for approval. Submission of individual data will not be accepted unless directed by Owner's Representative.
  - .2 Make changes as required and re-submit as directed by Owner's Representative.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Owner's Representative will provide 1 set of reproducible mechanical drawings or AutoCAD files. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

- .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
- .3 Use different colour for each service.
- .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Owner's Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

### 1.3 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.4 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

1.5        DELIVERY, STORAGE, AND HANDLING

- .1        Waste Management and Disposal:
  - .1        Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 02 41 99 - Demolition for Minor Works.

PART 2        PRODUCTS

2.1        MATERIALS

- .1        All materials used on this project shall be new and CSA approved unless noted otherwise.

PART 3        EXECUTION

3.1        PAINTING, REPAIRS AND RESTORATION

- .1        Do painting in accordance with Section 09 91 99 - Painting for Minor Works.
- .2        Prime and touch up marred finished paintwork to match original.
- .3        Restore to new condition, finishes which have been damaged.

3.2        CLEANING

- .1        Clean interior and exterior of all systems. Protect open ends of ducts, diffusers, grilles and registers during construction to prevent ingress of dust and dirt into interior of ducts. If dust or dirt is detected prior to startup, vacuum interior of all ducts and air handling units. Prior to vacuuming use video camera to record condition of ductwork. Also use video camera to record condition of ducts after cleaning.

3.3        FIELD QUALITY CONTROL

- .1        Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
  - .1        Submit tests as specified in other sections of this specification.

.2 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.

3.4 DEMONSTRATION

- .1 Owner's Representative will use equipment and systems for test purposes prior to acceptance. Contractor to supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Owner's Representative may record these demonstrations on video tape for future reference.

3.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system

END OF SECTION

PART 1      GENERAL

1.1      SUMMARY

- .1      Use of HVAC systems during construction.

1.2      USE OF SYSTEMS

- .1      Use of new and/or existing permanent heating and/or ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions: .
  - .1      Entire system is complete, pressure tested, cleaned, flushed out.
  - .2      Specified water treatment system has been commissioned, water treatment is being continuously monitored.
  - .3      Areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .4      There is no possibility of damage from any cause.
  - .5      Supply ventilation systems are protected by 60 % filters, which shall be inspected daily, changed every week or more frequently as required.
  - .6      Return systems have approved filters over all openings, inlets, outlets.
  - .7      All systems will be:
    - .1      operated as per manufacturer's recommendations or instructions.
    - .2      operated by Contractor.
    - .3      monitored continuously by Contractor.
  - .8      Warranties and guarantees are not thereby relaxed.
  - .9      Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Owner's Representative.
  - .10      Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, and replace filters in air systems.

- .2 Filters specified in this section are over and above those specified in other sections of this project.
- .3 Exhaust systems are not included in any approvals for temporary heating ventilation.

PART 2      PRODUCTS (NOT USED)

PART 3      EXECUTION (NOT USED)

END OF SECTION

PART 1      GENERAL

1.1      RELATED SECTIONS

- .1      Section 01 74 11 - Cleaning.
- .2      Section 02 41 99 - Demolition for Minor Works.
- .3      Section 07 84 00 - Firestopping.

1.2      REFERENCES

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

1.3      WASTE MANAGEMENT AND DISPOSAL

- .1      Separate and recycle waste materials in accordance with Section 02 41 99 - Demolition for Minor Works.
- .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 in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4      Divert unused metal materials from landfill to metal recycling facility approved by Engineer / Architect.

1.4      QUALITY ASSURANCE

- .1      Installers to be certified to journeyperson.

PART 2      PRODUCTS (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.



- .1 Unions are not required in installations using grooved mechanical couplings (The couplings shall serve as unions).

### 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 DIELECTRIC WATERWAY FITTINGS AND 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 waterway fittings, unions or bronze valves.
  - .1 Waterway fittings shall be complete with thermoplastic liner.

### 3.5 PIPEWORK INSTALLATION

- .1 Installation by certified journeyperson.
- .2 Screwed fittings jointed with Teflon tape or pipe dope as recommended by manufacturer.
- .3 Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions.

- .1 Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer.
- .2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
- .4 Push-to-connect piping: Prepare copper tube and install in strict accordance with installation instructions. Pipe ends shall be cleaned, free from indentations, projections, burrs and foreign matter. Use a tube preparation tool as supplied by the manufacturer to clean and make installation mark. Push copper tube into fittings to installation depth mark, per installation instructions. Keep fittings free of dirt and oil.
- .5 Protect openings against entry of foreign material.
- .6 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .7 Assemble piping using fittings manufactured to ANSI standards.
- .8 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.
- .9 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .10 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .11 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .12 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .13 Group piping wherever possible and as indicated.

- .14 Ream pipes, remove scale and other foreign material before assembly.
- .15 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .16 Provide for thermal expansion as indicated.
- .17 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 ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.

### 3.6 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 Provide space for firestopping. Maintain fire rating integrity.
  - .2 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

- .3 Ensure no contact between copper pipe or tube and sleeve.

### 3.7 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.

### 3.8 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 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

### 3.9 FLUSHING OUT OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant sections of other Divisions.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### 3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Owner's Representative, 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of other sections or Divisions.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of other Divisions.
- .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 Owner's Representative. Work to be carried out in off hours after 5 p.m., weekends or holidays.
- .6 Pay costs for repairs or replacement, retesting, and making good. Owner's Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Owner's Representative.

3.11 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Owner's Representative. Work to be carried out off hours after 5 p.m., weekends or holidays.
- .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      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 02 41 99 - Demolition for Minor Works
- .3      Section 23 05 23.01 - Valves - Bronze
- .4      Section 23 05 53.01 - Mechanical Identification

1.3      REFERENCES

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

1.4      SUBMITTALS

- .1      Submit 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:
  - .1      Thermometers
  - .2      Pressure Gauges
  - .3      Ball Valves

1.5      HEALTH AND SAFETY

- .1      Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6      WASTE MANAGEMENT AND DISPOSAL

- .1      Separate waste materials for reuse and recycling in accordance with Section 02 41 99 - Demolition for Minor Works.
- .2      Collect, separate and place in designated containers for reuse and recycling, paper, plastic, polystyrene, corrugated cardboard packaging, steel, metal, 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: dual imperial and metric.

2.2      DIRECT READING THERMOMETERS

- .1      Industrial, variable angle type, liquid filled, accuracy  $\pm 1$  scale division, 175 mm scale length: to CAN/CGSB14.4.
  - .1      Acceptable Product: Trerice, Ashcroft, Wika, Winters, Marsh.

2.3      THERMOMETER WELLS

- .1      Copper pipe: copper or bronze.
- .2      Steel pipe: brass or stainless steel.

2.4      PRESSURE GAUGES

- .1      112 mm, dial type: to ASME B40.1, Grade 2A, stainless steel or phosphor bronze bourdon tube having 0.5% accuracy full scale, 1% accuracy for liquid filled.
  - .1      Acceptable Product: Trerice, Ashcroft, Wika, Winters, Marsh.
- .2      Provide:

- .1 Siphon for steam service.
- .2 Snubber for pulsating operation.
- .3 Diaphragm assembly for corrosive service.
- .4 Gasketted pressure relief back with solid front.
- .5 Bronze ball valve to Section 23 05 23.01 - Valves - Bronze.
- .6 Oil filled for high vibration applications, such as pumps.

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 and on inlet and outlet of:
  - .1 DHW tanks.
- .3 Install wells.
- .4 Use extensions where thermometers are installed through insulation.

3.3      PRESSURE GAUGES

- .1 Install ball valves.
- .2 Use extensions where pressure gauges are installed through insulation.

3.4      NAMEPLATES

- .1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION



PART 1        GENERAL

1.1        SUMMARY

- .1        Section Includes:
  - .1        Bronze - valves.

1.2        RELATED SECTIONS

- .1        Section 01 33 00 - Submittal Procedures
- .2        Section 01 35 29.06 - Health and Safety Requirements.
- .3        Section 02 41 99 - Demolition for Minor Works.
- .4        Section 01 78 00 - Closeout Submittals.
- .5        Section 23 05 05 - Installation of Pipework

1.3        REFERENCES

- .1        American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1        ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch.)
  - .2        ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings
  - .3        ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .2        American Society for Testing and Materials (ASTM)
  - .1        ASTM A 276, Specification for Stainless Steel Bars and Shapes.
  - .2        ASTM A536, Specification for Ductile Iron Castings.
  - .3        ASTM B 16, Specification for Free-Cutting Brass Rod Bar and Shapes for Use in Screw Machines.
  - .4        ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
  - .5        ASTM B 283, Specification for Copper and Copper Alloy Die Forgings (Hot Pressed)
  - .6        ASTM B 505/B505M, Specification for Copper-Base Alloy Continuous Castings.
  - .7        ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.

- .3 Canadian Standards Association (CSA)
  - .1 CSA B242, Groove and Solder Type Mechanical Pipe Couplings.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  - .1 MSS SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2 MSS SP-80, Bronze Gate, Globe, Angle and Check Valves.
  - .3 MSS SP-110, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

#### 1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit data for valves specified this section.
  - .3 Grooved joint couplings and fittings to be indicated on product submittals and to be specifically identified with the applicable style or series designation.
- .3 Closeout Submittals
  - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### 1.5 QUALITY ASSURANCE

- .1 Health and Safety
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 All grooved joint couplings, fittings, valves, and specialties to be the products of a single manufacturer. Grooving tools to be of the same manufacturer as the grooved components.

1.6        DELIVERY, STORAGE AND DISPOSAL

- .1        Waste Management and Disposal
  - .1        Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/Demolition Waste Management and Disposal.
  - .2        Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.7        MAINTENANCE

- .1        Extra Materials
  - .1        Furnish following spare parts:
    - .1        Valve seats: one for every 10 valves each size. Minimum 1.
    - .2        Discs: one for every 10 valves, each size. Minimum 1.
    - .3        Stem packing: one for every 10 valves, each size. Minimum 1.
    - .4        Valve handles: 2 of each size.
    - .5        Gaskets for flanges: one for every 10 flanged joints.
    - .6        Grooved couplings: IPS and copper-tube dimensioned, one for every 10 (ten) grooved joints.

PART 2        PRODUCTS

2.1        MATERIALS

- .1        Except for specialty valves, to be single manufacturer.
- .2        All products to have Canadian registration numbers (CRN).
- .3        End Connections
  - .1        Connection into adjacent piping/tubing:
    - .1        Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
    - .2        Copper tube systems.
      - .1        Solder ends ANSI/ASME B16.18.

- .2 Grooved ends to copper tube dimensions and CSA B242.
- .3 Push-to-connect ends to ANSI/ASME B16.22 and manufacturer's standards.
- .4 Lockshield Keys
  - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

## 2.2 BALL VALVES

- .1 NPS 2 and under:
  - .1 Body and cap: cast high tensile bronze to ASTM B16 or ASTM B62.
  - .2 Pressure rating: Class 125, 860 MPa steam.
  - .3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders. Push-to-connect, Pressfit ends.
  - .4 Stem: tamperproof ball drive.
  - .5 Stem packing nut: external to body.
  - .6 Ball and seat: replaceable stainless steel or hard chrome, plated brass solid ball and teflon seats.
  - .7 Stem seal: TFE, EPDM, Nitrile, Fluoroelastomer with with external packing nut.
  - .8 Operator: removable lever handle with extension for insulated pipe.
  - .9 Cap and drain for drain service.

## 2.3 ACCEPTABLE PRODUCT

- .1 Acceptable Product: Jenkins, Crane, Watts, Newman Hattersley, Milwaukee, Conbraco, Kitz, Red White, M.A. Stewart, Nibco, Victaulic.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Adjoining tube, couplings, and fittings with grooved joint valves shall be copper-tube dimensioned. Flaring tube or fitting ends to accommodate IPS sized valves is not permitted.

- .4 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.
  - .1 Unions are not required in installations using grooved mechanical couplings. The couplings shall serve as unions.

3.2 COMMISSIONING

- .1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

END OF SECTION

PART 1      GENERAL

1.1      SUMMARY

- .1      Section includes:
  - .1      Hangers and supports for mechanical piping, ducting and equipment.

1.2      RELATED SECTIONS

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 02 41 99 - Demolition for Minor Works.

1.3      REFERENCES

- .1      American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
  - .1      ANSI/ASME B31.1, Power Piping, (SI Edition).
- .2      American Society for Testing and Materials (ASTM)
  - .1      ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
  - .2      ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3      ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3      Factory Mutual (FM)
- .4      Health Canada / Workplace Hazardous Materials Information System (WHMIS).
  - .1      Materials Safety Data Sheets (MSDS).
- .5      Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1      MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2      ANSI/MSS SP-69, Pipe Hangers and Supports - Selection and Application.
  - .3      MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6      Underwriter's Laboratories of Canada (ULC)

1.4        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 MSS SP58 or ASME B31.1.
- .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 all 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 to be in accordance with MSS SP58.

.2        Performance Requirements

- .1        Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the National Building Code

1.5        SUBMITTALS

- .1        Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Shop drawings: submit drawings stamped and signed for approval by Owner's Representative.
- .3        Submit shop drawings and product data for following items:
  - .1        Bases, hangers and supports.
  - .2        Connections to equipment and structure.
  - .3        Structural assemblies.
- .4        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 Owner's Representative will make available 1 copy of systems supplier's installation instructions.

.5 Closeout Submittals:

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

1.6 QUALITY ASSURANCE

.1 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common 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 02 41 99 - Demolition for Minor Works.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.
- .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 painted with zinc-rich paint after manufacture.
- .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
- .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

- .2 Upper attachment structural: Suspension from lower flange of I-Beam.



- .1 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, 13 mm FM approved.
- .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, FM approved where required to MSS-SP58 and MSS-SP69.
- .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 FM approved where required to MSS SP69.
  - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.
- .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 FM approved where required to MSS SP-69.
- .5 Shop and field-fabricated assemblies.
  - .1 Trapeze hanger assemblies: MSS SP-89.
  - .2 Steel brackets: MSS SP-89.
  - .3 Sway braces for seismic restraint systems: to MSS SP-89.
- .6 Hanger rods: threaded rod material to MSS SP-58.
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP-58.
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation saddles for hot pipework.

- .4 Oversize pipe hangers and supports for insulated pipes.
- .8 Adjustable clevis: material to MSS SP-69, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.
- .10 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

## 2.3

### RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.
- .2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## 2.4

### INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP-69, 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 SP-69.

## 2.5

### CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate

tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).

- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## 2.6 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 to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .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.

## 2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

## 2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

PART 3      EXECUTION

3.1      MANUFACTURER'S INSTRUCTIONS

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

3.2      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, elsewhere 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 be 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: most stringent requirements of Canadian Plumbing Code

- .2 Fire protection: to applicable fire code.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Within 300 mm of each elbow.
- .5 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, comprised of angel iron or c-channel.

### 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.

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.
- .2        Sustainable requirements for construction and verification.

1.2        RELATED SECTIONS

- .1        Section 01 33 00 - Submittal Procedures.
- .2        Section 02 41 99 - Demolition for Minor Works.
- .3        Section 09 91 99 - Painting for Minor Works.

1.3        REFERENCES

- .1        Canadian Gas Association (CGA)
  - .1        CSA/CGA B149.1, Natural Gas and Propane Installation Code.
  - .2        CSAZ7396.1 Medical Gas pipeline Systems - Part 1: Pipelines for medical gases and vacuum.
- .2        Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2        CAN/CGSB-24.3, Identification of Piping Systems.
- .3        National Fire Protection Association (NFPA)
  - .1        NFPA 13, Standard for the Installation of Sprinkler Systems.
  - .2        NFPA 14, Standard for the Standpipe and Hose Systems.

1.4        SUBMITTALS

.1        Product Data:

- .1        Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product data to include paint colour chips, other products specified in this section.
- .3        Samples:
  - .1        Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

#### 1.5 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common 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 02 41 99 - Demolition for Minor Works.
  - .2 Dispose of unused paint coating material at official hazardous material collections site approved by Engineer / Architect.
  - .3 Do not dispose of unused paint coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

### 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 to be 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 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Owner's Representative.

## 2.4 PIPING SYSTEMS GOVERNED BY CODES

### .1 Identification:

- .1 Sprinklers: to NFPA 13.

## 2.5 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 Pictograms:
  - .1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 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.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 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 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.
- .7 Colours and Legends:
  - .1 To match existing.

## 2.6 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.

- .3 Identify system : e.g. Supply AHU-1, Exhaust F-7.

## 2.7 VALVES, CONTROLLERS

- .1 Brass tags 12 mm diameter with 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.

## 2.8 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in section 25 05 54 - EMCS: Identification. If no EMCS included in project, identification as per this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position, component ID name.

## 2.9 LANGUAGE

- .1 Identification to be 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 all painting specified in Section 09 91 99 Painting for Minor Works 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 in any way.

### 3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, 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, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification to be 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 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Owner's Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus 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 certified to AABC, NBC, NEBB or SMACNA to perform TAB to Owner's Representative within 90 days of award of contract.
- .2      Provide documentation confirming qualifications, successful experience. TAB contractor shall have a minimum of 5 (five) years experience to AABC, NBC, NEBB or SMACNA.
- .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.
  - .2      National Balancing Council, (NBC) Certified Air Balancing Specifications and Certified Hydronic Balancing Specifications.
  - .3      National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
  - .4      Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .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 the 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, NBC, NEBB, or SMACNA), 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 so as 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 be 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 so as 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 Owner's

Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

- .2 Review specified standards and report to Owner's Representative in writing all 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 other Divisions.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Owner's Representative for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Owner's Representative 7 (seven) days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weatherstripping, sealing, caulking.
  - .3 All pressure, leakage, other tests specified elsewhere in other Divisions.
  - .4 All provisions for TAB installed and operational.
- .3 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.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
  - .1 Laboratory HVAC systems: plus 10%, minus 0%.
  - .2 Other HVAC systems: plus 5%, minus 5%.
  - .3 Hydronic systems: plus or minus 10 %.
  - .4 Refrigeration systems: plus or minus 10%.

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Owner's Representative list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 (three) months of TAB. Provide certificate of calibration to Owner's Representative.
- .4 Use ultrasonic flow measurement when balancing valves or pete's plugs are not installed.

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 Owner's Representative, 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 Format to be in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit 3 (three) copies of TAB Report to Owner's Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16      VERIFICATION

- .1 Reported results subject to verification by Owner's Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results to be at discretion of Owner's Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Owner's Representative.

1.17      SETTINGS

- .1 After TAB is completed to satisfaction of Owner's Representative, 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. Markings not to be eradicated or covered in any way.

1.18      COMPLETION OF TAB

- .1 TAB to be considered complete when final TAB Report received and approved by Owner's Representative.

1.19      AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NBC or NEBB.

- .2 Do TAB of systems, equipment, components, controls specified in other Divisions.
- .3 Qualifications: personnel performing TAB to be qualified to standards of AABC, NBC or NEBB.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC, NBC or NEBB.
- .5 Measurements: to include, but not limited to, following 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, amperage and volts for each stage of electrical heating coils.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 OTHER SYSTEMS

- .1 Wet pipe sprinkler systems:
  - .1 Standard: NFPA.
  - .2 TAB procedures: Refer to NFPA 13 Sprinkler System.

1.21 POST- OCCUPANCY TAB

- .1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of areas designated by Owner's Representative.
- .2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 3 months of termination of Warranty Period.

PART 2        PRODUCTS (NOT APPLICABLE)

PART 3        EXECUTION (NOT APPLICABLE)

END OF SECTION

## 1 GENERAL

### 1.01 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.

### 1.02 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
  - .1 SMACNA HVAC Air Duct Leakage Test Manual.

### 1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Contractors Verification.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
  - .1 Submit proposed report form and test report format to Departmental Representative for approval at least three weeks before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
  - .2 Prepare report of results and submit to Departmental Representative within 24 hours of completion of tests. Include:
    - .1 Schematic of entire system.
    - .2 Schematic of section under test showing test site.
    - .3 Required and achieved static pressures.
    - .4 Orifice differential pressure at test sites.
    - .5 Permissible and actual leakage flow rate (L/s) for test sites.
    - .6 Witnessed certification of results.
  - .3 Include test reports in final TAB report.

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's field reports specified.

## 2 PRODUCTS

### 2.01 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.
- .3 Submit details of test instruments to be used to Departmental Representative at least three weeks before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 7 days before start of tests.
- .5 Re-calibrated every [six] months thereafter.

## 3 EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

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

### 3.02 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.

### 3.03 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] %.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

### 3.04 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.
- .4 Flexible connections to VAV boxes.

### 3.05 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Section [01 47 17 - Sustainable Requirements: Contractor's Verification], include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified Wood.
  - .8 Low-emitting materials.
- .2 Performance Verification:
  - .1 Departmental Representative to witness tests and to verify reported results.

- .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

### 3.06 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 91 13 - General Commissioning (Cx)  
         Requirements: supplemented as specified herein.
- .2      Section 22 42 01 - Plumbing Specialities and  
         Accessories.
- .3      Section 23 05 93 - Testing, Adjusting and Balancing  
         for HVAC.
- .4      Section 22 11 16 - Domestic Water Piping Copper.

1.2      REFERENCES

- .1      ASTM E202, Standard Test Methods for Analysis of  
         Ethylene Glycols and Propylene Glycols.

1.3      WET AND DRY PIPE SPRINKLER SYSTEM

- .1      Cleaning, testing, start-up, performance verification  
         of equipment, systems, components, and devices is  
         specified elsewhere in other mechanical Divisions.
- .2      Verification of controls, detection devices, alarm  
         devices is specified other mechanical and electrical  
         Divisions.
- .3      Verify operation of interlocks between HVAC systems  
         and fire alarm systems.

1.4      SANITARY DRAINAGE SYSTEMS

- .1      Buried systems: Perform tests prior to back-filling.  
         Perform hydraulic tests to verify grades and freedom  
         from obstructions.
- .2      Ensure that traps are fully and permanently primed.
- .3      Ensure that fixtures are properly anchored, connected  
         to system.
- .4      Operate flush valves, tank and operate each fixture to  
         verify drainage and no leakage.
- .5      Cleanouts: Refer to Section 22 42 01 - Plumbing  
         Specialities and Accessories.

1.5        REPORTS

- .1        In accordance with Section 01 91 41 - Commissioning Training Requirements: supplemented as specified herein.

1.6        TRAINING

- .1        In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: supplemented as specified in relevant specification sections

PART 2        PRODUCTS (NOT APPLICABLE)

PART 3        EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1      GENERAL

1.1      SUMMARY

- .1      Section includes:
  - .1      Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2      RELATED SECTIONS

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 35 29.06 - Health and Safety Requirements
- .3      Section 02 41 99 - Demolition for Minor Works.
- .4      Section 01 91 13 - General Commissioning (Cx) Requirements.
- .5      Section 07 84 00 - Firestopping
- .6      Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.3      REFERENCES

- .1      American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2      American Society for Testing and Materials International, (ASTM).
  - .1      ASTM A 480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2      ASTM A 635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3      ASTM A 653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3      Department of Justice Canada (Jus).
  - .1      Canadian Environmental Protection Act (CEPA).
- .4      Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1      Material Safety Data Sheets (MSDS).
- .5      National Fire Protection Association (NFPA).

- .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual.
  - .3 IAQ Guideline for Occupied Buildings Under Construction, 1st Edition.
- .7 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA).

#### 1.4 SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
  - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
  - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

#### 1.6 DELIVERY, STORAGE AND HANDLING

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

.2 Waste Management and Disposal:

- .1 Separate waste materials for reuse and recycling in accordance with Section 02 41 99 - Demolition for Minor Works.
- .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 in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

PART 2      PRODUCTS

2.1      SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
> 1000	A
750	B
500	C
250	C
125	C

.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 tape or combination thereof.
- .3 Class C: transverse joints and connections made air tight with gaskets, sealant tape or combination thereof. Longitudinal seams unsealed.

2.2      SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°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 Duct Leakage Test Manual.

2.5        FITTINGS

- .1        Fabrication: to SMACNA.
- .2        Radiused elbows:
  - .1        Rectangular: Centreline radius: 1.5 times width of duct.
  - .2        Round: smooth radius or 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 or 45<sup>0</sup> entry on branch.
  - .2        Round main and branch: enter main duct at 45<sup>0</sup> with conical connection.
  - .3        Provide volume control damper in branch duct near connection to main duct.
  - .4        Main duct branches: with volume control damper.
- .5        Transitions:
  - .1        Diverging: 20<sup>0</sup> maximum included angle.
  - .2        Converging: 30<sup>0</sup> maximum included angle.
- .6        Offsets:
  - .1        Full short radiused elbows as indicated.
- .7        Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6        FIRESTOPPING

- .1        Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.

- .2 Firestopping material and installation must not distort duct.

## 2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653, G90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

## 2.8 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: galvanized steel angle with black steel rods to ASHRAE or SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.
    - .1 Acceptable Product: Myatt, Grinnell, Hunt.
  - .2 For steel joist: manufactured joist clamp steel plate washer.
    - .1 Acceptable Product: Myatt, Grinnell, Hunt.
  - .3 For steel beams: manufactured beam clamps:
    - .1 Acceptable Product: Myatt, Grinnell, Hunt.

## PART 3 EXECUTION

### 3.1 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.

- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation. Do not place fire stopping material in expansion space between damper sleeve and fire partition.
- .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 or as follows:

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

### 3.3 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. Sealant and tape to be applied to full perimeter of duct.

### 3.4 LEAKAGE TESTS/COMMISSIONING

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Do leakage tests in sections.
- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Install no additional ductwork until trial test has been passed.
- .5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90° elbows.



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Designated Support Space	Metal Ducts - Low	Section 23 31 13 01
1 <sup>st</sup> Floor JCB	Pressure to 500 Pa	Page 7
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.6 Complete test before insulation or concealment.

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.

1.2      RELATED SECTIONS

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 35 29.06 - Health and Safety Requirements.
- .3      Section 01 45 00 - Quality Control.
- .4      Section 02 41 99 - Demolition for Minor Works.
- .5      Section 01 78 00 - Closeout Submittals.

1.3      REFERENCES

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

1.4      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.
  - .2      Submit WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### 1.5 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 02 41 99 - Demolition for Minor Works.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

- .3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
- .4 Separate for reuse and recycling and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan (WMP).
- .5 Divert unused metal materials from landfill to metal recycling facility as approved by Owner's Representative.

## 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 0.66 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<sup>0</sup>C to plus 90<sup>0</sup>C, density of 1.3 kg/m<sup>2</sup>.

### 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 Hold open devices.
  - .2 300 x 300 mm glass viewing panels.
  - .3 Up to 300 x 300 mm: two sash locks complete with safety chain.

- .4 301 to 450 mm: four sash locks complete with safety chain.
- .5 451 to 1000 mm: piano hinge and minimum two sash locks.
- .6 Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .1 Hold open devices.
  - .2 300 X 300 mm glass viewing panels.

#### 2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

#### 2.5 INSTRUMENT TEST PORTS

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

#### 2.6 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 datasheet.

#### 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.
      - .2 450 x 450 mm for servicing entry.
      - .3 300 x 300 mm for viewing.
      - .4 As indicated.
    - .2 Locations:
      - .1 Fire and smoke dampers.
      - .2 Control dampers.
      - .3 Devices requiring maintenance.
      - .4 Required by code.
      - .5 Reheat coils.
      - .6 Elsewhere as indicated.
  - .3 Instrument test ports.
    - .1 General:
      - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
    - .2 Locate to permit easy manipulation of instruments.
    - .3 Install insulation port extensions as required.
    - .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 Owner's Representative.
  - .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 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer's representative of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within 3 days of review, and submit, immediately, to Owner's Representative.

### 3.4 CLEANING

- .1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning 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      RELATED SECTIONS:

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 35 29.06 - Health and Safety Requirements.
- .3      Section 01 45 00 - Quality Control.
- .4      Section 02 41 99 - Demolition for Minor Works.
- .5      Section 01 78 00 - Closeout Submittals.

1.3      REFERENCES

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

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.
    - .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      Indicate the following:
      - .1      Specifications.

.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.

.2 Instructions: Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 02 41 99 - Demolition for Minor Works.

PART 2 PRODUCTS

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, 0.8 mm up to 450 mm wide, 1.6 mm maximum up to 1200 mm wide, 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 or bronze end bearings.

.5 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      For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .4      Runouts to registers and diffusers: located as close as possible to main ducts.
- .5      All dampers to be vibration free.
- .6      Ensure damper operators are observable and accessible.

3.3      CLEANING

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

END OF SECTION

PART 1      GENERAL

1.1      SUMMARY

.1      Section Includes:

- .1      Fire and smoke dampers, and fire stop flaps.

1.2      RELATED SECTIONS

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 35 29.06 - Health and Safety Requirements.
- .3      Section 02 41 99 - Demolition for Minor Works.
- .4      Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.

1.3      REFERENCES

- .1      American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  - .1      ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2      Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1      Material Safety Data Sheets (MSDS).
- .3      Underwriters Laboratories of Canada (ULC)
  - .1      CAN4-S112, Fire Test of Fire Damper Assemblies.
  - .2      CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
  - .3      ULC-S505, Fusible Links for Fire Protection Service.

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.
  - .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 Indicate the following:
  - .1 Fire dampers.
  - .2 Smoke dampers.
  - .3 Fire stop flaps.
  - .4 Operators.
  - .5 Fusible links.
  - .6 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.
  - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Certificates:
  - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.6 MAINTENANCE

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide the following:
    - .1 6 fusible links of each type.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common 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 02 41 99 - Demolition for Minor Works.

## PART 2      PRODUCTS

### 2.1      FIRE DAMPERS

- .1 Fire dampers: arrangement Type B or C, blades out of air stream listed and bear label of ULC, meet requirements of provincial fire authority and ANSI/NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN4-S112. Minimum rating 1 ½ hours, dynamically rated.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: offset, round or square; multi-blade hinged or interlocking type; roll door type; or guillotine type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 Retaining angle iron frame, 40 x 40 x 3 mm, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed to prevent disruption of 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 Fire, Smoke, and Radiation Damper Installation Guide for HVAC and in manufacturer's instructions for fire dampers shall be followed.

## 2.2 SMOKE DAMPERS

- .1 To be ULC or UL listed and labelled.
- .2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.
- .3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units mounted horizontally in vertical ducts.
- .4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
- .5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74 °C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

## 2.3 COMBINATION FIRE AND SMOKE DAMPERS

- .1 Damper: similar in all respects to smoke dampers specified above.

- .2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

#### 2.4 FIRE STOP FLAPS

- .1 To be ULC listed and labelled and fire tested in accordance with CAN4-S112.2.
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps to be held open with fusible link conforming to ULC-S505 and close at 74 °C.

### 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 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.
- .5 Coordinate with installer of firestopping to Section 07 84 00 - 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 11 - Cleaning.



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

#### 3.4 COMMISSIONING

- .1 Commission in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

END OF SECTION

PART 1      GENERAL

1.1      SUMMARY

- .1      Section Includes:
  - .1      Materials and installation of flexible ductwork, joints and accessories.

1.2      RELATED SECTIONS

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 35 29.06 - Health and Safety Requirements.
- .3      Section 02 41 99 - Demolition for Minor Works.
- .4      Section 01 91 13 - General Commissioning (Cx) Requirements.

1.3      REFERENCES

- .1      American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2      Department of Justice Canada (Jus).
  - .1      Canadian Environmental Protection Act (CEPA).
  - .2      Transportation of Dangerous Goods Act, (TDGA).
- .3      Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1      Material Safety Data Sheets (MSDS).
- .4      National Fire Protection Association (NFPA).
  - .1      NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2      NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .5      Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
  - .1      SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - .2      SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .6      Underwriters' Laboratories Inc. (UL).
  - .1      UL 181, Standard for Factory-Made Air Ducts and Air Connectors.

- .7 Underwriters' Laboratories of Canada (ULC).
- .1 CAN/ULC-S110, Fire Tests for Air Ducts.

#### 1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS for the following:
  - .1 Thermal properties.
  - .2 Friction loss.
  - .3 Acoustical loss.
  - .4 Leakage.
  - .5 Fire rating.
- .3 Samples: submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00 - Submittal Procedures.

#### 1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
  - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 02 41 99 - Demolition for Minor Works.
  - .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 in appropriate on-site bins for recycling in accordance with Waste Management Plan.

- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .6 Ensure emptied containers are sealed and stored safely.
- .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.7 INDOOR AIR QUALITY (IAQ)

- .1 During construction, meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

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 METALLIC - UNINSULATED

- .1 Type 1: spiral wound flexible aluminum.
- .2 Performance:
  - .1 Factory tested to 1000 Pa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

2.3 METALLIC - INSULATED

- .1 Type 2: spiral wound flexible aluminum with factory applied, 25 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl or reinforced mylar/neoprene laminate jacket.
- .2 Performance:
  - .1 Factory tested to 1000 Pa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Thermal loss/gain: 1.3 W/m<sup>2</sup>.°C. mean.

PART 3      EXECUTION

3.1      DUCT INSTALLATION

- .1      Install in accordance with: NFPA 90A and NFPA 90B  
SMACNA.
- .2      Do leakage test in accordance with Section 23 05 94 -  
Pressure Testing of Ducted Air System.
- .3      Do trial test to demonstrate workmanship.

END OF SECTION

PART 1      GENERAL

1.1      SECTION INCLUDES

- .1      Materials and installation for acoustic duct lining.

1.2      RELATED SECTIONS

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 35 29.06 - Health and Safety Requirements.
- .3      Section 02 41 99 - Demolition for Minor Works.

1.3      REFERENCES

- .1      American Society for Testing and Materials International, (ASTM).
  - .1      ASTM C 423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2      ASTM C 916, Standard Specification for Adhesives for Duct Thermal Insulation.
  - .3      ASTM C 1071, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - .4      ASTM C 1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .5      ASTM G 21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2      Department of Justice Canada (Jus).
  - .1      Canadian Environmental Protection Act (CEPA).
- .3      Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1      Material Safety Data Sheets (MSDS).
- .4      National Fire Protection Association (NFPA).
  - .1      NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
  - .2      NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .5      Thermal Insulation Association of Canada(TIAC).
  - .1      National Insulation Standards.

- .6 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
  - .1 SMACNA, HVAC DCS HVAC, Duct Construction Standards, Metal and Flexible.
  - .2 SMACNA IAQ Guideline for Occupied Buildings 95.
- .7 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .8 Underwriter's Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.4 SUBMITTALS

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

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

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

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 02 41 99 - Demolition for Minor Works.
- .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 in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA , Regional and Municipal regulations.

- .6 Ensure emptied containers are sealed and stored safely.
- .7 Fold up metal banding, flatten and place in designated area for recycling.

PART 2      PRODUCTS

2.1      DUCT LINER

.1      General:

- .1 Mineral Fibre duct liner: air surface coated mat facing.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102, NFPA 90A and NFPA 90B.
- .3 Fungi resistance: to ASTM C 1338, ASTM G 21.

.2      Rigid:

- .1 Use on flat surfaces where indicated
- .2 25 mm thick, to ASTM C 1071, Type 2, fibrous glass rigid board duct liner.
- .3 Density: 48 kg/m<sup>3</sup> minimum.
- .4 Thermal resistance to be minimum 0.76 (m<sup>2</sup>.degrees C)/W for 25 mm thickness, 1.15 (m<sup>2</sup>.degrees C)/W for 38 mm thickness, 1.53 (m<sup>2</sup>.degrees C)/W for 50 mm thickness when tested in accordance with ASTM C 177, at 24 degrees C mean temperature.
- .5 Maximum velocity on faced air side: 20.3 m/sec.
- .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C 423.

.3      Flexible:

- .1 Use on round or oval surfaces.
- .2 25 mm thick, to ASTM C 1071 Type 1, fibrous glass blanket duct liner.
- .3 Density: 24 kg/m<sup>3</sup> minimum.
- .4 Thermal resistance to be minimum 0.37 (m<sup>2</sup>.degrees C)/W for 12 mm thickness, 0.74 (m<sup>2</sup>.degrees C)/W for 25 mm thickness, 1.11 (m<sup>2</sup>.degrees C)/W for 38 mm thickness, 1.41 (m<sup>2</sup>.degrees C)/W to 50 mm thickness when tested in accordance with ASTM C 177, at 24 degrees C mean temperature.
- .5 Maximum velocity on coated air side: 25.4 m/sec.



- .6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C 423.

## 2.2 ADHESIVE

- .1 Adhesive: to NFPA 90A and NFPA 90B, ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.
- .3 Water-based fire retardant type.

## 2.3 FASTENERS

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

## 2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

## 2.5 SEALER

- .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

# PART 3 EXECUTION

## 3.1 GENERAL

- .1 Do work in accordance with SMACNA HVAC DCS, NIAC, FGDLs and as indicated except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

## 3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
  - .1 Fasten to interior sheet metal surface with 100 % coverage of adhesive to ASTM C 916

- .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
- .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.
- .1 Spacing of mechanical fasteners in accordance with SMACNA HVAC, DCS, TIAC.
- .2 In systems, where air velocities exceed 20.3 m/sec, install galvanized sheet metal nosing to leading edges of duct liner.

### 3.3

#### JOINTS

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
  - .1 Bed tape in sealer.
  - .2 Apply two coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Owner's Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

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 use.

1.2      RELATED SECTIONS

.1      Section 01 33 00 - Submittal Procedures.

.2      Section 02 41 9 - Demolition for Minor Works.

.3      Section 01 78 00 - Closeout Submittals.

1.3      REFERENCES

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

.1      ASHRAE 70, Method of Testing for Rating the Performance of Air Ducts and Outlets.

1.4      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.

1.5      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.

Indicate following:

- .1      Capacity
- .2      Throw and terminal velocity
- .3      Noise criteria
- .4      Pressure drop
- .5      Neck velocity

- .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.
  - .2 Instructions: submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common 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 02 41 99 - Demolition for Minor Works.

1.8 MAINTENANCE

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - 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, pressure drop, terminal velocity, throw, noise level, neck velocity.
- .2 Frames:
  - .1 Full perimeter gaskets.

- .2 Plaster frames where set into plaster or gypsum board.
- .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators as indicated.
- .4 Colour: standard or as directed by Owner's Representative.
- .5 Acceptable Product: E. H. Price, Titus, Nailor, Carnes, Krueger, Tuttle & Bailey.

## 2.2 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

## 2.3 GRILLES, REGISTERS AND DIFFUSERS

- .1 Grilles, registers and diffusers shall be E.H. Price, Titus, Drueger, Carnes, Nailor, and Tuttle & Bailey.
- .2 All grilles, diffusers and registers shall be of type and size indicated on drawings and shall be complete with O.B. damper unless otherwise noted.
- .3 Grilles & Diffusers are as follows:
  - Type A - E.H. Price 8"/LTA/48 linear slot diffuser. Coordinate installation with linear slot ceiling.
  - Type B - E.H. Price 12x12/SCD/31/B12, size 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 in accordance with manufacturers instructions.
- .2 Install with flat head stainless steel or cadmium plated screws in countersunk holes where fastenings are visible.

- .3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
- .4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere.

### 3.3 CLEANING

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

END OF SECTION

PART 1      GENERAL

1.1      REFERENCES

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

1.2      ACTION AND INFORMATIONAL 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 (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
  - .2      Product data to include:
    - .1      Filters, fan accessibility.
    - .2      Suspension of cabinet.
    - .3      Physical size.
    - .4      Thermostat, transformer, controls where integral.
    - .5      Finish.
    - .6      kW rating, voltage, phase.
    - .7      Cabinet material thickness.
- .2      Shop Drawings:
  - .1      Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .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.

1.3        QUALITY ASSURANCE

.1        Health and Safety:

- .1        Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4        DELIVERY, STORAGE AND HANDLING

.1        Packing, shipping, handling and unloading:

- .1        Deliver, store and handle in accordance with manufacturer's written instructions and section 01 61 00 - Common Product Requirements.

.2        Waste Management and Disposal:

- .1        Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Disposal.

PART 2        PRODUCTS

2.1        SUSTAINABLE REQUIREMENTS

- .1        Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2        FAN COIL UNITS

- .1        Cabinet: steel, 1.2mm thick, floor mounting, recessed. Front inlet.
- .2        Elements: stainless steel sheathed with corrosion protected aluminum fins covering full length of element.
- .3        Blower motors: one speed, single phase.
- .4        Fan delay switch.
- .5        Assembly fully wired to one outlet location.
- .6        Multiple knockouts for up to 38mm diameter conduit.



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        Mount units.
- .2        Make power and control connections.

3.3        FIELD QUALITY CONTROL

- .1        Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.4        CLEANING

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

END OF SECTION