

## 1 General

### 1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Saskatchewan, Canada.
  - .2 Indicate on drawings:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .3 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.
  - .4 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.

### 1.02 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .2 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 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .3 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.
- .4 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.
- .5 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. 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 waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 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 Departmental 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.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### 1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.

---

#### **1.04 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect products from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **2 Products**

#### **2.01 NOT USED**

### **3 Execution**

#### **3.01 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

#### **3.02 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

#### **3.03 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

#### **3.04 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. 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 Departmental Representative will record these demonstrations on video tape for future reference.

**3.05 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.06 PROTECTION**

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

**END OF SECTION**

## 1 General

### 1.01 REFERENCES

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA B139-15, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .4 National Fire Code of Canada (NFCC 2015)
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-A2010, Architectural Coatings.
  - .2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

### 1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## 2 Products

- .1 Not used.

## 3 Execution

### 3.01 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

---

### **3.02 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

### **3.03 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada, CSA B139.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

### **3.04 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.
  - .1 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.

### **3.05 DIELECTRIC COUPLINGS**

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

### **3.06 PIPEWORK INSTALLATION**

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .6 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .8 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .9 Group piping wherever possible.
- .10 Ream pipes, remove scale and other foreign material before assembly.

- .11 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .12 Provide for thermal expansion as indicated.
- .13 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Use ball valves at branch take-offs for isolating purposes except where specified.

### 3.07 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere:
    - .1 Provide space for firestopping.
    - .2 Maintain fire rating integrity.
  - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### 3.08 ESCUTCHEONS

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

### 3.09 PREPARATION FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

### **3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

### **3.11 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval by Departmental Representative 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

### **3.12 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for [reuse] [recycling] in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

**END OF SECTION**

## 1 General

### 1.01 REFERENCES

- .1 ASTM International
  - .1 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM A563-15, Standard Specification for Carbon and Alloy Steel Nuts.
- .2 Factory Mutual (FM)
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .4 Underwriter's Laboratories of Canada (ULC)

### 1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 .

### 1.03 CLOSEOUT SUBMITTALS

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

### 1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## 2 Products

### 2.01 SYSTEM DESCRIPTION

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

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

## 2.02 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

## 2.03 PIPE HANGERS

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized after manufacture.
  - .2 Use hot dipped galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are copper plated.
- .2 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 to MSS SP69.
- .3 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm rod.
- .4 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .5 Adjustable clevis: material to MSS SP69, 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.
- .6 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .7 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.
- .8 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.04 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

## **2.05 EQUIPMENT SUPPORTS**

- .1 Equipment supports to be provided by the manufacturer.

## **2.06 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **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 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
  - .2 .
- .2 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .3 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .4 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.
- .5 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.

### **3.03 HANGER SPACING**

- .1 Plumbing piping: to authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.

- .4 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .5 Within [300] mm of each elbow.

| Maximum Pipe Size : NPS | Maximum Spacing Steel | Maximum Spacing Copper |
|-------------------------|-----------------------|------------------------|
| up to 1-1/4             | 2.4 m                 | 1.8 m                  |
| 1-1/2                   | 3.0 m                 | 2.4 m                  |
| 2                       | 3.0 m                 | 2.4 m                  |
| 2-1/2                   | 3.7 m                 | 3.0 m                  |
| 3                       | 3.7 m                 | 3.0 m                  |
| 3-1/2                   | 3.7 m                 | 3.3 m                  |
| 4                       | 3.7 m                 | 3.6 m                  |
| 5                       | 4.3 m                 |                        |
| 6                       | 4.3 m                 |                        |
| 8                       | 4.3 m                 |                        |
| 10                      | 4.9 m                 |                        |
| 12                      | 4.9 m                 |                        |

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

### 3.04 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### 3.05 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.

### 3.06 FINAL ADJUSTMENT

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

**3.07 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

THIS PAGE INTENTIONALLY LEFT BLANK

## 1 General

### 1.01 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.

### 1.02 REFERENCES

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-12, Identification of Piping Systems.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 13-2016, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14-2016, Standard for the Installation of Standpipe and Hose Systems.

### 1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .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.

### 1.04 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.

### 1.05 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: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Dispose of unused material at official hazardous material collections site approved by Departmental Representative.

- .3 Do not dispose of unused material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## 2 Products

### 2.01 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### 2.02 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] [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.
- .5 Identification for PWGSC Preventive Maintenance Support System (PMSS):
  - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
  - .2 Equipment in Mechanical Room:
    - .1 Main identifier: size #9.
    - .2 Source and Destination identifiers: size #6.
    - .3 Terminal cabinets, control panels: size #5.
  - .3 Equipment elsewhere: sizes as appropriate.

### 2.03 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 Departmental Representative.

### 2.04 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: 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 Other pipes: pressure sensitive plastic-coated cloth with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
  - .1 Where not listed, obtain direction from Departmental Representative.
  - .2 Colours for legends, arrows: to following table:

| Background colour: | Legend, arrows: |
|--------------------|-----------------|
| Yellow             | BLACK           |
| Green              | WHITE           |
| Red                | WHITE           |

- .3 Background colour marking and legends for piping systems:

| Contents                               | Background colour marking | Legend         |
|--|---------------------------|----------------|
| ** Add design temperature              |                           |                |
| ++ Add design temperature and pressure |                           |                |
| Domestic hot water supply              | Green                     | DOM. HW SUPPLY |
| Dom. HWS recirculation                 | Green                     | DOM. HW CIRC   |

|                            |       |           |
|----------------------------|-------|-----------|
| Domestic cold water supply | Green | DOM. CWS  |
| Sanitary                   | Green | SAN       |
| Plumbing vent              | Green | SAN. VENT |

## **2.05 IDENTIFICATION DUCTWORK SYSTEMS**

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

## **2.06 VALVES, CONTROLLERS**

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

## **2.07 CONTROLS COMPONENTS IDENTIFICATION**

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

## **2.08 LANGUAGE**

- .1 Identification in English.
- .2 Use one nameplate and label.

## **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 TIMING**

- .1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

### **3.03 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

### **3.04 NAMEPLATES**

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

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

### **3.05 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, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.06 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 Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

### **3.07 FIELD QUALITY CONTROL**

- .1 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.

### **3.08 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**

## 1 General

### 1.01 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.

### 1.02 QUALIFICATIONS OF TAB PERSONNEL

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

### 1.03 PURPOSE OF TAB

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

- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

#### **1.04 EXCEPTIONS**

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

#### **1.05 CO-ORDINATION**

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

#### **1.06 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started confirm in writing to Departmental 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 Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

#### **1.07 START-UP**

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

#### **1.08 OPERATION OF SYSTEMS DURING TAB**

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

#### **1.09 START OF TAB**

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.

- .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
- .4 Correct fan rotation.
- .5 Fire, smoke, volume control dampers installed and open.
- .6 Coil fins combed, clean.
- .7 Access doors, installed, closed.
- .8 Outlets installed, volume control dampers open.
- .3 Liquid systems:
  - .1 Flushed, filled, vented.
  - .2 Correct pump rotation.
  - .3 Strainers in place, baskets clean.
  - .4 Isolating and balancing valves installed, open.
  - .5 Calibrated balancing valves installed, at factory settings.
  - .6 Chemical treatment systems complete, operational.

#### **1.10 APPLICATION TOLERANCES**

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

#### **1.11 ACCURACY TOLERANCES**

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

#### **1.12 INSTRUMENTS**

- .1 Prior to TAB, submit to Departmental Representative list of instruments 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 months of TAB. Provide certificate of calibration to Departmental Representative.

#### **1.13 ACTION AND INFORMATIONAL 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 Departmental 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 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 6 copies of TAB Report to Departmental 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 Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

#### **1.17 SETTINGS**

- .1 After TAB is completed to satisfaction of Departmental 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. Do not eradicate or cover markings.

#### **1.18 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

#### **1.19 AIR SYSTEMS**

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

#### **1.20 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified this section.
  - .2 Quality assurance: as for air systems specified this section.

**END OF SECTION**

THIS PAGE INTENTIONALLY LEFT BLANK

## 1 General

### 1.01 REFERENCES

- .1 Definitions:
  - .1 For purposes of this section:
    - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
    - .2 "EXPOSED" - means "not concealed" as previously defined.
    - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
  - .2 TIAC Codes:
    - .1 CRD: Code Round Ductwork,
    - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
  - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2 ASTM International Inc.
    - .1 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .2 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .3 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .4 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
    - .5 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .6 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
  - .5 Underwriters Laboratories of Canada (ULC)
    - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
    - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

## 1.02 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

## 1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

## 2 Products

### 2.01 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### 2.02 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C553.

### 2.03 ELASTOMERIC CELLULAR THERMAL DUCT LINER

- .1 Manufacturers:
  - .1 Armacell AP Armaflex Sheets
  - .2 Other acceptable manufacturers offering equivalent products.
- .2 Insulation: Flexible, closed-cell elastomeric insulation in sheet form meeting ASTM C 534,
  - .1 'ksi' ('K') value : ASTM C177, 0.039 at 24 degrees C (0.27 at 75 degrees F).
  - .2 Maximum service temperature: 105 degrees C (220 degrees F).
  - .3 Maximum Velocity on Coated Air Side: 30.5 m/s (6,000 fpm).
  - .4 Minimum Noise Reduction Criteria: ASTM C423,
    - .1 0.35 for 32 mm (1-1/4 inches) thickness
- .3 Elastomeric Foam Adhesive
  - .1 Manufacturers:

- .1 Armstrong 520 adhesive.
- .2 Air dried, contact adhesive, compatible with insulation.

#### **2.04 JACKETS**

- .1 Lagging adhesive: compatible with insulation.

#### **2.05 ACCESSORIES**

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .5 Contact adhesive: quick-setting
- .6 Tie wire: 1.5 mm stainless steel.
- .7 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .8 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face of insulation.
- .9 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

### **3 Execution**

#### **3.01 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

#### **3.02 PRE-INSTALLATION REQUIREMENTS**

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

#### **3.03 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum [2] rows each side.

### 3.04 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

|   | TIAC Code | Vapour Retarder | Thickness (mm) |
|---|-----------|-----------------|----------------|
| Rectangular air supply and return air ductwork where indicated on drawings by acoustic hatching symbol. | None.     | No              | 32             |
| Rectangular cold and dual temperature supply air ducts  | C-1       | yes             | 50             |
| Round cold and dual temperature supply air ducts  | C-2       | yes             | 50             |
| Supply, return and exhaust ducts exposed in space being served  | none      |                 |                |
| Acoustically lined ducts  | none      | No              | 32             |

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

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

.1 Finishes: conform to following table:

| TIAC Code         |             |       |
|-------------------|-------------|-------|
|                   | Rectangular | Round |
| Indoor, concealed | none        | none  |

### 3.05 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## 1 General

### 1.01 SUMMARY

- .1 Section Includes:
  - .1 Thermal insulation for piping and piping accessories in commercial type applications.

### 1.02 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C335-17, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .2 ASTM C411-17, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .3 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .4 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Assessment Act (CEAA), 2012, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings
  - .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

### 1.03 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

### 1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

### 1.05 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
- .3 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.06 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 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.

## 2 Products

### 2.01 FIRE AND SMOKE RATING

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

### 2.02 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702.
  - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702.

### 2.03 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.

### 2.04 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

### 2.05 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

**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 PRE-INSTALLATION REQUIREMENT**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

**3.03 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

**3.04 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
  - .1 Securements: Tape at 300 mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
  - .1 Securements: Tape at 300 mm on centre.
  - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .4 Thickness of insulation as listed in following table.
  - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

| Applica-tion | Temp degrees C | TIAC code | Pipe sizes (NPS) and insulation thickness (mm) |    |    |    |    |  |  |  |  |  |  |
|--------------|----------------|-----------|--|----|----|----|----|--|--|--|--|--|--|
| Domestic     | [A-1]          | 25        | 25   | 25 | 38 | 38 | 38 |  |  |  |  |  |  |

|                 |       |    |    |    |    |    |    |  |  |  |  |  |  |  |
|-----------------|-------|----|----|----|----|----|----|--|--|--|--|--|--|--|
| HWS             |       |    |    |    |    |    |    |  |  |  |  |  |  |  |
| Domestic<br>CWS | [A-3] | 25 | 25 | 25 | 25 | 25 | 25 |  |  |  |  |  |  |  |

- .5 Finishes:
  - .1 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .2 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
  - .3 Installation: to appropriate TIAC code CRF/1 through CPF/5.

**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.

**3.06 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**

THIS PAGE INTENTIONALLY LEFT BLANK

## 1 General

### 1.01 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
  - .1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
  - .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1168, Adhesives and Sealants Applications.

### 1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for [metal ducts] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Saskatchewan, Canada.
- .4 Test and Evaluation Reports:
  - .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.

### 1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect metal ducts from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

## 2 Products

### 2.01 SEAL CLASSIFICATION

- .1 Classification as follows:

| Maximum Pressure Pa | SMACNA Seal Class |
|---------------------|-------------------|
| 500                 | C                 |
| 250                 | C                 |
| 125                 | C                 |
| 125                 | Unsealed          |

- .2 Seal classification:
  - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
  - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape, or combination thereof.
  - .3 Class C: transverse joints and connections made air tight and water tight with sealant. Longitudinal seams unsealed. Ensure economical and quiet performance of system.
  - .4 Unsealed seams and joints.

### 2.02 SEALANT

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

### 2.03 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: short radius with single thickness turning vanes.
  - .2 Round: smooth radius, 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 45 degrees entry on branch
  - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
  - .3 Provide volume control damper in branch duct near connection to main duct.
  - .4 Main duct branches: with splitter damper.
- .5 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:

- .1 As indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.

#### 2.04 FIRE STOPPING

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

#### 2.05 GALVANIZED STEEL

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

#### 2.06 HANGERS AND SUPPORTS

- .1 Hangers and Supports:.
  - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
    - .1 Maximum size duct supported by strap hanger: [500].
  - .2 Hanger configuration: to SMACNA.
  - .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA or the following table, which ever is more stringent:

| Duct Size<br>(mm) | Angle Size<br>(mm) | Rod Size<br>(mm) |
|-------------------|--------------------|------------------|
| up to 750         | 25 x 25 x 3        | 6                |
| 751 to 1050       | 40 x 40 x 3        | 6                |
| 1051 to 1500      | 40 x 40 x 3        | 10               |
| 1501 to 2100      | 50 x 50 x 3        | 10               |
| 2101 to 2400      | 50 x 50 x 5        | 10               |
| 2401 and over     | 50 x 50 x 6        | 10               |

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.

### 3 Execution

#### 3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### 3.02 GENERAL

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

### 3.03 HANGERS

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

| Duct Size<br>(mm) | Spacing<br>(mm) |
|-------------------|-----------------|
| to 1500           | 3000            |
| 1501 and over     | 2500            |

### 3.04 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA.
- .2 Prior to application, ductwork to be dry and free of grease, etc.
- .3 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.
- .4 Use 6mm bead of material along joints. Material, when dry, to have 3.2mm depth extending 25mm on each side of joint or seam.
- .5 Sealant shall be inspected by the departmental representative prior to insulating of ductwork. Any defects, if any, shall be remedied at no additional cost to the owner.

### 3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

## 1 General

### 1.01 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

### 1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Instrument test ports.

### 1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 2 Products

### 2.01 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

### 2.02 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m<sup>2</sup>.

### 2.03 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 Gaskets: neoprene.
- .3 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain
  - .2 Hold open devices.

#### 2.04 INSTRUMENT TEST

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

### 3 Execution

#### 3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

#### 3.02 INSTALLATION

- .1 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air VAVs.
    - .2 Inlets and outlets of exhaust air fans.
  - .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 Locations:
    - .1 Control dampers.
- .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.

### **3.03 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

THIS PAGE INTENTIONALLY LEFT BLANK

## **1 General**

### **1.01 REFERENCES**

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

### **1.02 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.03 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

### **1.04 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect dampers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **2 Products**

### **2.01 GENERAL**

- .1 Manufacture to SMACNA standards.

### **2.02 SINGLE BLADE DAMPERS**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA.
- .3 Locking quadrant.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

---

### **3 Execution**

#### **3.01 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.

#### **3.02 INSTALLATION**

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

#### **3.03 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

## 1 General

### 1.01 REFERENCES

- .1 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112, Standard Test Method of Fire Test of Fire Damper Assemblies.
  - .2 CAN/ULC-S112.2, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
  - .3 ULC-S505, Standard for Fusible Links for Fire Protection Service.

### 1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for [fire and smoke dampers] and include product characteristics, performance criteria, physical size, finish and limitations.
  - .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.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### 1.03 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire dampers for incorporation into manual.

### 1.04 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

### 1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect fire dampers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 2 Products

### 2.01 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B, listed ULC, meet requirements of authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
  - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged interlocking type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 Retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damper HVAC and in manufacturer's instructions for fire dampers shall be followed.

## 3 Execution

### 3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for fire and smoke damper installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.02 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 Co-ordinate with installer of fire stopping.
- .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.

### **3.03 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

THIS PAGE INTENTIONALLY LEFT BLANK

## 1 General

### 1.01 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 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.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
  - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2005.
- .4 Underwriters' Laboratories (UL)
  - .1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S110, Standard Methods of Tests for Air Ducts.

### 1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate:
    - .1 Thermal properties.
    - .2 Friction loss.
    - .3 Acoustical loss.
    - .4 Leakage.
    - .5 Fire rating.

### 1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

---

## 2 Products

### 2.01 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.

### 2.02 NON-METALLIC - UNINSULATED

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

## 3 Execution

### 3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for flexible ducts installation in accordance with manufacturer's written instructions.

### 3.02 DUCT INSTALLATION

- .1 Install in accordance with: SMACNA
- .2 Maximum installed length: One continuous length at 1500 mm (5'-0"). Use standard sheetmetal elbows at drop points to outlets.

### 3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

## 1 General

### 1.01 REFERENCES

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/AMCA Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO)
  - .1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-18, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .4 Underwriter's Laboratories (UL)
  - .1 UL 181-2005(R2008), Factory-Made Air Ducts and Air Connectors.

## 2 Products

### 2.01 VARIABLE VOLUME BOXES

- .1 Pressure independent reset to air flow between minimum and maximum air volume. Low Pressure bypass to direct excess air flow to ceiling plenum.
- .2 Controls Contractor shall verify site conditions prior to providing any equipment or controls shop drawings.
- .3 Sizes, capacities, differential pressures and sound ratings: as indicated.
- .4 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.
- .5 Complete with:
  - .1 Operator and controller: connect into existing controls system.
  - .2 Sound attenuator: 4 foot in length.
  - .3 Multiport outlet adapter: as indicated.
- .6 Minimum 35 kPa reset span.
- .7 Adjustable reset start point.
- .8 Casing: constructed of galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL181 and NFPA 90A. Mount control components inside protective metal shroud.
- .9 Damper: galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

### **3 Execution**

#### **3.01 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal units installation in accordance with manufacturer's written instructions.

#### **3.02 INSTALLATION**

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

#### **3.03 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

## 1 General

### 1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.

### 1.02 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

### 1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 2 Products

### 2.01 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.

### 2.02 GENERAL

- .1 To meet capacity, as scheduled.
- .2 Frames:

- .1 Full perimeter gaskets.
- .2 Countersunk screwholes.
- .3 Colour: Pre-finished white.

### **2.03 MANUFACTURED UNITS**

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

### **2.04 DIFFUSERS**

- .1 General: volume control dampers with flow straightening devices and blank-off quadrants and gaskets.
- .2 Type S-, S-2 and S-3: steel, square plaque type, having fixed pattern, lay-in mounted. Finish: white.

### **2.05 RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1 Type R-1 and R-2: Aluminum, 19 mm border, 25 x 25 mm egg crate type face bars. Finish: baked enamel, white.
- .2 Type R-3: Steel, 19 mm border, single blade 45 degrees deflection, horizontal face bars. Finish: baked enamel, white.

## **3 Execution**

### **3.01 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.

### **3.02 INSTALLATION**

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head screws in countersunk holes where fastenings are visible.

### **3.03 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**