

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

1. Section 23 05 01 - Use of HVAC systems during construction
2. Section 23 05 29 – Hangers and supports for HVAC piping and equipment
3. Section 23 05 53.01 - Mechanical identification
4. Section 23 05 93 – Testing, adjusting and balancing for HVAC
5. Section 23 07 13 - Thermal insulation for ducting
6. Section 23 07 15 - Thermal insulation for piping
7. Section 23 31 13.01 - Metal ducts – Low pressure to 500 PA
8. Section 23 33 15 - Dampers – Operating
9. Section 23 33 16 – Dampers – Fire
10. Section 26 05 00 - Common Work Results – For Electrical

### **1.2 SUBMITTALS**

1. Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  2. Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
  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.
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6. Closeout Submittals:
    1. Provide operation and maintenance data.
    2. Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
    3. Operation data to include:
      - a. Control schematics for systems including environmental controls.
      - b. Description of systems and their controls.
    4. Maintenance data to include:
      - a. Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
      - b. Data to include schedules of tasks, frequency, tools required and task time.
    5. Performance data to include:
      - a. Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
      - b. Equipment performance verification test results.
      - c. Special performance data as specified.
    6. Approvals:
      - a. 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.
      - b. Make changes as required and re-submit as directed by Departmental Representative.
    7. Additional data:
      - a. Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
    8. Site records:
      - a. Departmental Representative will provide 1 set of reproducible mechanical drawings. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
      - b. Transfer information to reproducibles, revising reproducibles to show work as actually installed.
      - c. Use different colour waterproof ink for each service.
      - d. Make available for reference purposes and inspection.
  7. 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.
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5. Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
8. 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 30 - Health and Safety Requirements.

### **1.4 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 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

## **PART 3 - EXECUTION**

### **3.1 PAINTING REPAIRS AND RESTORATION**

1. Prime and touch up marred finished paintwork to match original.
2. Restore to new condition, finishes which have been damaged.

### **3.2 CLEANING**

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

### **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.

### **3.4 PROTECTION**

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

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

### **1.2 REFERENCES**

1. American Society of Mechanical Engineers (ASME)
  1. ASME B31.1-[07], Power Piping.
2. ASTM International
  1. ASTM A 125-[1996(2007)], Standard Specification for Steel Springs, Helical, Heat-Treated.
  2. ASTM A 307-[07b], Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  3. ASTM A 563-[07a], Standard Specification for Carbon and Alloy Steel Nuts.
3. Factory Mutual (FM)
4. Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  1. MSS SP 58-[2002], Pipe Hangers and Supports - Materials, Design and Manufacture.
  2. MSS SP 69-[2003], Pipe Hangers and Supports - Selection and Application.
  3. MSS SP 89-[2003], Pipe Hangers and Supports - Fabrication and Installation Practices.
5. Underwriter's Laboratories of Canada (ULC)

### **1.3 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.
  3. Shop Drawings:
    1. Submit shop drawings for:
      - a. Bases, hangers and supports.
      - b. Connections to equipment and structure.
      - c. Structural assemblies.
  4. Certificates:
    1. Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
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5. Manufacturers' Instructions:
  1. Provide manufacturer's installation instructions.

#### **1.4 CLOSEOUT SUBMITTALS**

1. Provide maintenance data.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

1. Delivery and Acceptance Requirements:
  1. Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

### **PART 2 - PRODUCTS**

#### **2.1 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 SP 58.
  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 SP 58.

#### **2.2 GENERAL**

1. Fabricate hangers, supports and sway braces in accordance with MSS SP 58. ANSI B31.1 and
2. Use components for intended design purpose only. Do not use for rigging or erection purposes.

#### **2.3 PIPE HANGERS**

1. Finishes:
    1. Pipe hangers and supports: galvanized after manufacture.
    2. Use electro-plating 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.
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2. Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP 69.
3. 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 rod.
4. Pipe attachments: material to MSS SP 58:
  1. Attachments for copper piping: copper plated black steel.
  2. Use insulation shields for hot pipework.
  3. Oversize pipe hangers and supports.
5. Adjustable clevis: material to MSS SP 69 UL listed, 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. U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
  1. Finishes for copper : black] galvanized .
7. Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

## **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 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.
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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.

### **3.3 HANGER SPACING**

1. Plumbing piping: to [Canadian Plumbing Code] [Provincial Code] [authority having jurisdiction].
2. Copper piping: up to NPS 1/2: every 1.5 m.

### **3.4 HANGER INSTALLATION**

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

### **3.5 HORIZONTAL MOVEMENT**

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

### **3.6 FINAL ADJUSTMENT**

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

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

**3.8 CLEANING**

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

**END OF SECTION**

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## **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 REFERENCES**

1. Canadian Gas Association (CGA)
  1. CSA/CGA B149.1-[05], Natural Gas and Propane Installation Code.
2. Canadian General Standards Board (CGSB)
  1. CAN/CGSB-1.60-[97], Interior Alkyd Gloss Enamel.
  2. CAN/CGSB-24.3-[92], Identification of Piping Systems.
3. National Fire Protection Association (NFPA)
  1. NFPA 13-[2002], Standard for the Installation of Sprinkler Systems.
  2. NFPA 14-[2003], Standard for the Installation of Standpipe and Hose Systems.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

### **1.4 QUALITY ASSURANCE**

1. Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

1. Packing, shipping, handling and unloading:
    1. Deliver, store and handle materials in accordance with manufacturer's written instructions.
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## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

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

### **2.2 SYSTEM NAMEPLATES**

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

<b>Size</b>	<b>Sizes (mm)</b>	<b>No. of lines</b>	<b>Height of letters (mm)</b>
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].
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5. Identification for PWGSC Preventive Maintenance Support System (PMSS):
  1. Use arrangement of Main identifier, Source identifier, Destination identifier.
  2. Equipment in Mechanical Room:
    - a. Main identifier: size #9.
    - b. Source and Destination identifiers: size #6.
    - c. Terminal cabinets, control panels: size #5.
  3. Equipment elsewhere: sizes as appropriate.

### **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 Departmental Representative.

### **2.4 IDENTIFICATION OF PIPING SYSTEMS**

1. Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
  2. 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] [vinyl] with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
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## 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
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT

## 2.5 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.

## 2.6 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.

## 2.7 CONTROLS COMPONENTS IDENTIFICATION

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

## 2.8 LANGUAGE

1. Identification in English and French.
2. Use one nameplate and label for both languages.

## **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 painting specified Section [09 91 23 - Interior Painting] has been completed.

### **3.3 INSTALLATION**

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

### **3.4 NAMEPLATES**

1. Locations:
  1. In conspicuous location to facilitate easy reading and identification from operating floor.
2. Standoffs:
  1. Provide for nameplates on hot and/or insulated surfaces.
3. Protection:
  1. Do not paint, insulate or cover.

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

1. On long straight runs in open areas in 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.
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8. At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
  9. Identification easily and accurately readable from usual operating areas and from access points.
    1. Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.6 VALVES, CONTROLLERS**

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

### **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, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

### **1.2 REFERENCES**

1. American Society of Mechanical Engineers (ASME)
  1. ASME B31.1-[07], Power Piping.

### **1.3 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.

### **1.4 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. AB 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.
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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.

## **1.5 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.

## **1.6 EXCEPTIONS**

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

## **1.7 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.

## **1.8 PRE-TAB REVIEW**

1. Review contract documents before project construction is started and 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.

## **1.9 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.
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**1.10 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.

**1.11 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:
    - a. Filters in place, clean.
    - b. Duct systems clean.
    - c. Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - d. Correct fan rotation.
    - e. Fire, smoke, volume control dampers installed and open.
    - f. Coil fins combed, clean.
    - g. Access doors, installed, closed.
    - h. Outlets installed, volume control dampers open.

**1.12 APPLICATION TOLERANCES**

1. Do TAB to following tolerances of design values:
  1. HVAC systems: plus 10 %, minus 10 %.

**1.13 ACCURACY TOLERANCES**

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

**1.14 INSTRUMENTS**

1. Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
  2. Calibrate within [3] months of TAB. Provide certificate of calibration to Departmental Representative.
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**1.15 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.16 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.

**1.17 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 3 copies of TAB Report to Departmental Representative for verification and approval, in both official languages in D-ring binders, complete with index tabs.

**1.18 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.

**1.19 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.

**1.20 COMPLETION OF TAB**

1. TAB considered complete when final TAB Report received and approved by Departmental Representative .
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**1.21 AIR SYSTEMS**

1. Standard: TAB to most stringent of TAB standards of SMACNA, ASHRAE.
2. Do TAB of systems ECH-1.
3. Qualifications: personnel performing TAB NEBB.
4. Quality assurance: perform TAB under direction of supervisor qualified to standards of NEBB.
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).

**1.22 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.

**1.23 POST-OCCUPANCY TAB**

1. Participate in systems checks twice during Warranty Period - #1 approximately [3] months after acceptance and #2 within [1] month of termination of Warranty Period.

**PART 2 - PRODUCTS****2.1 NOT USED**

1. Not used.

**PART 3 - EXECUTION****3.1 NOT USED**

1. Not used.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

1. Section 01 33 00 - Submittal Procedures.

### **1.2 REFERENCES**

1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  1. ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
2. American Society for Testing and Materials International, (ASTM)
  1. ASTM B 209M-02, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  2. ASTM C 335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  3. ASTM C 411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  4. ASTM C 449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  5. ASTM C 547-00, Specification for Mineral Fiber Pipe Insulation.
  6. ASTM C 553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  7. ASTM C 612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
  8. ASTM C 795-92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  9. ASTM C 921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
3. Canadian General Standards Board (CGSB)
  1. CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
4. Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
5. Underwriters Laboratories of Canada (ULC)
  1. CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.
  2. CAN/ULC-S701-01, Thermal Insulation Polyotrene, Boards and Pipe Covering.

### **1.3 DEFINITIONS**

1. For purposes of this section:
    1. "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
-

2. "EXPOSED" - will mean "not concealed" as defined herein.
3. Insulation systems - insulation material, fasteners, jackets, and other accessories.

2. TIAC Codes:

1. CRD: Code Round Ductwork,
2. CRF: Code Rectangular Finish.

#### **1.4 SHOP DRAWINGS**

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

#### **1.5 SAMPLES**

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

#### **1.6 MANUFACTURERS' INSTRUCTIONS**

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

#### **1.7 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, qualified to standards of TIAC.

#### **1.8 DELIVERY, STORAGE AND HANDLING**

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

#### **1.9 WASTE MANAGEMENT AND DISPOSAL**

1. Separate and recycle waste materials.
  2. Remove from site and dispose of packaging materials at appropriate recycling facilities.
  3. Collect and separate for disposal packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
-

4. Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
5. Divert unused adhesive material from landfill to official hazardous material collections site approved by Departmental Representative.
6. Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

## **PART 2 - PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

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

### **2.2 INSULATION**

1. Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
2. Thermal conductivity ("k" factor) not to exceed specified values at 24° C mean temperature when tested in accordance with ASTM C 335.
3. TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
4. TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  1. Mineral fibre: to ASTM C 553.
  2. Jacket: to CGSB 51-GP-52Ma.
  3. Maximum "k" factor: to ASTM C 553.

### **2.3 JACKETS**

1. Canvas:
  1. 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
2. Lagging adhesive: Compatible with insulation.

### **2.4 ACCESSORIES**

1. Vapour retarder lap adhesive:
    1. Water based, fire retardant type, compatible with insulation.
  2. Insulating Cement: [hydraulic] setting on mineral wool, to ASTM C 449.
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3. ULC Listed Canvas Jacket:
  1. 220 gm/m<sup>2</sup> cotton, plain weave, [treated with dilute fire retardant lagging adhesive to ASTM C 921] [untreated].
4. Tape: self-adhesive, aluminum, [plain] [reinforced], [50] [75] mm wide minimum.
5. Contact adhesive: quick-setting
6. Canvas adhesive: washable.
7. Tie wire: 1.5 mm stainless steel.
8. Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

## **PART 3 - EXECUTION**

### **3.1 PRE-INSTALLATION REQUIREMENTS**

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

### **3.2 INSTALLATION**

1. Install in accordance with TIAC National Standards.
2. Apply materials in accordance with manufacturers instructions and as indicated.
3. Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
4. Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  1. Hangers, supports to be outside vapour retarder jacket.
5. Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

### **3.3 DUCTWORK INSULATION SCHEDULE**

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

	<b>TIAC Code</b>	<b>Vapour retarder</b>	<b>Thickness (mm)</b>
Outside Plenum and air ducts to heat recovery ECH-1	C1	yes	50

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 SUMMARY**

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

### **1.2 REFERENCES**

1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    1. ASHRAE Standard 90.1-[01], 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 B 209M-[04], Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
    2. ASTM C 335-[04], Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
    3. ASTM C 411-[04], Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    4. ASTM C 449/C 449M-[00], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    5. ASTM C 533-[2004], Calcium Silicate Block and Pipe Thermal Insulation.
    6. ASTM C 547-[2003], Mineral Fiber Pipe Insulation.
    7. ASTM C 795-[03], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    8. ASTM C 921-[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.
    2. CAN/CGSB-51.53-[95], Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
  4. Department of Justice Canada (Jus)
    1. Canadian Environmental Assessment Act (CEAA), 1995, 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).
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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-[03], Surface Burning Characteristics of Building Materials and Assemblies.
  2. CAN/ULC-S701-[01], Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  3. CAN/ULC-S702-[1997], Thermal Insulation, Mineral Fibre, for Buildings
  4. CAN/ULC-S702.2-[03], Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

### **1.3 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.

### **1.4 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.
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## **1.5 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 member of TIAC.
3. Health and Safety:
  1. .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 materials in accordance with manufacturer's written instructions.
  2. 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.
3. Waste Management and Disposal:
  1. Place excess or unused insulation and insulation accessory materials in designated containers.
  2. Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  3. Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## **PART 2 - PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

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

### **2.2 INSULATION**

1. Mineral fibre 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 C 335.
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3. TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  1. Mineral fibre: to [CAN/ULC-S702] [ASTM C 547].
  2. Jacket: to CGSB 51-GP-52Ma.
  3. Maximum "k" factor: to [CAN/ULC-S702] [ASTM C 547].

### **2.3 INSULATION SECUREMENT**

1. Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
2. Contact adhesive: quick setting.
3. Canvas adhesive: washable.
4. Tie wire: [1.5] mm diameter stainless steel.
5. Bands: stainless steel, [19] mm wide, [0.5] mm thick.

### **2.4 CEMENT**

1. Thermal insulating and finishing cement:
  1. Air drying on mineral wool, to ASTM C 449/C 449M.

### **2.5 VAPOUR RETARDER LAP ADHESIVE**

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

### **2.6 INDOOR VAPOUR RETARDER FINISH**

1. Vinyl emulsion type acrylic, compatible with insulation.

### **2.7 JACKETS**

1. Canvas:
  1. 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
  2. Lagging adhesive: compatible with insulation.

## **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 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.
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**3.3 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.

**3.4 PIPING INSULATION SCHEDULES**

1. Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
2. 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].
3. 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.

Application	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			To 1	1 ¼ to 2	2 ½ to 4	5 to 6	8 et over	
Domestic HWS		A-3	38	38	38	50	50	50
Domestic CWS		A-3	25	25	25	40	40	40
Exhaust system vent a distance of 3 meters from outside		A3	40	40	40	40	40	40

4. Finishes:
  1. Exposed indoors: canvas.

**3.5 FIELD QUALITY CONTROL**

**3.6 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**

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## **PART 1 - GENERAL**

### **1.1 SUMMARY**

1. Section Includes:
  1. Materials and installation of low-pressure metallic ductwork, joints and accessories.
2. Related Sections:
  1. Section 01 33 00 - Submittal Procedures.
  2. Section 01 35 29.06 - Health and Safety Requirements.

### **1.2 REFERENCES**

1. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
  2. American Society for Testing and Materials International, (ASTM).
    1. ASTM A 480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
    2. ASTM A 635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
    3. ASTM A 653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
  3. Department of Justice Canada (Jus).
    1. Canadian Environmental Protection Act (CEPA), 1999, c. 33 .
  4. Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    1. Material Safety Data Sheets (MSDS).
  5. National Fire Protection Association (NFPA).
    1. NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
    2. NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  6. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
    1. SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
    2. SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
    3. IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.
  7. Transport Canada (TC).
    1. Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
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### **1.3 SUBMITTALS**

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

### **1.4 QUALITY ASSURANCE**

1. Certification of Ratings:
  1. Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
2. Health and Safety:
  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.

### **1.5 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.
    2. Remove from site and dispose of packaging materials at appropriate recycling facilities.
    3. Collect and separate for disposal 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 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 and Regional and Municipal regulations.
    7. Fold up metal and plastic banding, flatten and place in designated area for recycling.
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## **PART 2 - PRODUCTS**

### **2.1 SEAL CLASSIFICATION**

1. Classification as follows:

<b>Maximum Pressure Pa</b>	<b>SMACNA Seal Class</b>
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 with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.
4. Unsealed seams and joints.

### **2.2 SEALANT**

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

### **2.3 TAPE**

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

### **2.4 DUCT LEAKAGE**

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

### **2.5 FITTINGS**

1. Fabrication: to SMACNA.

### **2.6 GALVANIZED STEEL**

1. Lock forming quality: to ASTM A 653/A653M, Z90 zinc coating.
  2. Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
  3. Joints: to ASHRAE and SMACNA.
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**PART 3 - EXECUTION****3.1 GENERAL**

1. Do work in accordance with ASHRAE and SMACNA.
2. Do not break continuity of insulation vapour barrier with hangers or rods.
  1. Insulate strap hangers 100 mm beyond insulated duct.
3. Support risers in accordance with ASHRAE and SMACNA as indicated.

**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 ASHRAE and SMACNA

**3.3 WATERTIGHT DUCT**

1. Provide watertight duct for:
  1. Fresh air intake.
  2. As indicated.
2. Form bottom of horizontal duct without longitudinal seams.
  1. Weld joints of bottom and side sheets.
  2. Seal other joints with duct sealer.
3. Fit base of riser with 150 mm deep drain sump and 25 mm drain connected, and discharging to open funnel drain.

**3.4 SEALING AND TAPING**

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

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 SUMMARY**

1. Section Includes:
  1. Operating dampers for mechanical forced air ventilation and air conditioning systems.
  2. Sustainable requirements for construction and verification.

### **1.2 REFERENCES**

1. American Society for Testing and Materials International (ASTM)
  1. ASTM A 653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
2. Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  1. Material Safety Data Sheets (MSDS).

### **1.3 SUBMITTALS**

1. Product Data:
  1. Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - a. 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:
    - a. Performance data.
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.
    - a. Departmental Representative will make available 1 copy of systems supplier's installation instructions.
3. Closeout Submittals
  1. Provide maintenance data.

### **1.4 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.
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2. Certificates:

1. Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

## **1.5 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.

## **PART 2 - PRODUCTS**

### **2.1 MULTI-LEAF DAMPERS**

1. Parallel blade type as indicated and thermally insulated damper with severe cold and salt water resistance.
  2. Frames shall be 101.6mm deep x 25.4 mm and no less than 2.03mm in thickness, extruded aluminum (6063-T5) with mounting flanges on both sides of frame. Aluminum frame shall be clear anodized to a minimum thickness of 0.7 mil (18 microns) deep. Frame to be assembled using stainless steel screws.
  3. Blades shall be extruded aluminum (6063-T5) air-foil profiles, internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55. Extruded aluminum blades shall be clear anodized to a minimum thickness of 0.7mil (18 microns) deep.
  4. Blade and frame seals shall be of extruded silicone and shall be secured in an integral slot within the aluminum extrusions. Blade and frame seals are to be mechanically fastened to eliminate shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals shall not be approved.
  5. Maintenance-free bearings fixed to a 11.11 mm aluminum hexagon blade pivot pin, rotating within a polycarbonate outer bearing inserted into the frame. There shall be no metal-to-metal or metal-to-plastic contact. Aluminum blade pivot pin shall be clear anodized.
  6. Adjustable 11.11mm hexagonal drive rod, U-bolt fastener and retaining nuts shall be hexagonal, stainless steel to provide positive connection to blades and linkage.
  7. Linkage hardware to be installed in the frame side. All aluminum linkage hardware parts shall be clear anodized. All non-aluminum linkage hardware parts shall be stainless steel. To be complete with cup-point trunnion screws for slip-proof grip.
  8. Dampers are to be designed for operation in temperatures ranging between -40°F (-40°C) and 212°F (100°C).
  9. Dampers shall be rated Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential. Standard air leakage data shall be certified under the AMCA Certified Ratings Program.
  10. Dampers shall be made to size required without blanking off free area.
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11. Dampers shall be available with either opposed blade action or parallel blade action.
  12. Dampers must be mounting types : "Flanged to Duct".
  13. Installation of dampers must be in accordance with installation guidelines, provided with each damper shipment.
  14. Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

1. Install where indicated.
2. Install in accordance with recommendations of SMACNA and manufacturer's instructions.
3. Seal multiple damper modules with silicon sealant.

### **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**

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## **PART 1 - GENERAL**

### **1.1 SUMMARY**

1. Section Includes:
  1. Fire and smoke dampers, and fire stop flaps.

### **1.2 REFERENCES**

1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  1. ANSI/NFPA 90A-[2002], Standard for the Installation of Air Conditioning and Ventilating Systems.
2. Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  1. Material Safety Data Sheets (MSDS).
3. Underwriters Laboratories of Canada (ULC)
  1. CAN4-S112-[M1990], Fire Test of Fire Damper Assemblies.
  2. CAN4-S112.2-[M84], Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
  3. ULC-S505-[1974], Fusible Links for Fire Protection Service.

### **1.3 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.
      - a. 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:
      - a. Fire dampers.
      - b. Smoke dampers.
      - c. Fire stop flaps.
      - d. Operators.
      - e. Fusible links.
      - f. 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.
      - a. Departmental Representative will make available 1 copy of systems supplier's installation instructions.
-

3. Closeout Submittals:
  1. Provide maintenance data.

#### **1.4 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.

#### **1.5 MAINTENANCE**

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

#### **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 [01 74 21 - Construction/Demolition Waste Management and Disposal].

### **PART 2 - PRODUCTS**

#### **2.1 FIRE DAMPERS**

1. Fire dampers: arrangement Type A, listed and bear label of ULC meet requirements and ANSI/NFPA 90A. Fire damper assemblies fire tested in accordance with CAN4-S112.
  2. Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
    1. Fire dampers : 1-1/2 hour fire rated unless otherwise indicated.
    2. Fire dampers : automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
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3. Top hinged: offset single damper, round or square; guillotine type; sized to maintain full duct cross section [as indicated].
4. Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
5. [40 x 40 x 3] mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
6. Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
7. Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
8. Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
9. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
10. Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

1. Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
2. Maintain integrity of fire separation.
3. After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
4. Install access door adjacent to each damper.
5. Co-ordinate with installer of firestopping.
6. Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
7. Install break-away joints of approved design on each side of fire separation.

### **3.3 CLEANING**

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

**END OF SECTION**

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