

USE OF HVAC SYSTEM DURING CONSTRUCTION

**Part 1 General**

**1.1 USE OF SYSTEMS**

- .1 Use of new and existing permanent heating or ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:
  - .1 Entire system is complete, pressure tested, cleaned, flushed out.
  - .2 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .3 There is no possibility of damage.
  - .4 Supply ventilation systems are protected by MERV8 filters, inspected daily, changed every 2 weeks or more frequently as required.
  - .5 Return systems have approved filters over openings, inlets, outlets.
  - .6 Systems will be:
    - .1 Operated as per manufacturer's recommendations and instructions.
    - .2 Operated by Contractor.
    - .3 Monitored continuously by Contractor.
  - .7 Warranties and guarantees are not relaxed.
  - .8 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Contract Administrator.
  - .9 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.
- .2 Filters specified in this Section are over and above those specified in other Sections of this project.
- .3 Exhaust systems are not included in approvals for temporary heating ventilation.

**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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INSTALLATION OF PIPEWORK

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**Part 1            General**

**1.1                REFERENCES**

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

**Part 2            Products**

**2.1                NOT USED**

- .1            Not Used.

**Part 3            Execution**

**3.1                CONNECTIONS TO EQUIPMENT**

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

**3.2                CLEARANCES**

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

**3.3                DRAINS**

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

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INSTALLATION OF PIPEWORK

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**3.4 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.

**3.5 PIPEWORK INSTALLATION**

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, and conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .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 otherwise indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.

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INSTALLATION OF PIPEWORK

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- .5 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .14 Check Valves:
  - .1 Install swing check valves in horizontal lines on discharge of pumps.

**3.6 SLEEVES**

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

**3.7 ESCUTCHEONS**

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

**3.8 PREPARATION FOR FIRESTOPPING**

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.

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INSTALLATION OF PIPEWORK

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- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

**3.9 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant sections of Division 21 and 23.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

**3.10 LEAK TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of Division 21 and 23.
- .3 Maintain specified test pressure without loss for 2 hours minimum unless specified for longer period of time in relevant sections of Division 21 and 23.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Contract Administrator.
- .6 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Contract Administrator.

**3.11 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Contract Administrator.
- .2 Request written approval 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.

**END OF SECTION**

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COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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**Part 1            General**

**1.1                SUMMARY**

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

**1.2                REFERENCES**

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

**1.3                SUBMITTALS**

- .1    Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .3    Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1    Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2    Instructions: submit manufacturer's installation instructions.
- .4    Closeout Submittals
  - .1    Provide maintenance data for motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.4                DELIVERY, STORAGE, AND HANDLING**

- .1    Packing, shipping, handling and unloading:
  - .1    Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

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COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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

**Part 2 Products**

**2.1 GENERAL**

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

**2.2 MOTORS**

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 208V, unless otherwise indicated.

**2.3 TEMPORARY MOTORS**

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

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

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

**3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
  - .1 Bump motors to insure proper rotation.
  - .2 Confirm amperage and voltage draws for each leg.

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COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

**3.4 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**



VALVES - BRONZE

**Part 1 General**

**1.1 SUMMARY**

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
  - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A276, Specification for Stainless Steel Bars and Shapes.
  - .2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
  - .3 ASTM B283, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  - .4 ASTM B505/B505M, Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  - .1 MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2 MSS-SP-80, Bronze Gate Globe, Angle and Check Valves.
  - .3 MSS-SP-110, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

**1.3 SUBMITTALS**

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

**Part 2 Products**

**2.1 MATERIALS**

- .1 Valves:
  - .1 Except for specialty valves, to be single manufacturer.
  - .2 All products to have CRN registration numbers.
- .2 End Connections:
  - .1 Connection into adjacent piping/tubing:
    - .1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.

VALVES - BRONZE

- .2 Copper tube systems: Solder ends to ANSI/ASME B16.18.
- .3 Check Valves:
  - .1 Requirements common to check valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Connections: screwed with hexagonal shoulders.
  - .2 NPS 2 and under, swing type, bronze disc, Class 125:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .4 Silent Check Valves:
  - .1 NPS 2 and under:
    - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
    - .2 Pressure rating: Class 125.
    - .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
    - .4 Disc and seat: renewable rotating disc.
    - .5 Stainless steel spring, heavy duty.
    - .6 Seat: regrindable.
- .5 Ball Valves:
  - .1 NPS 2 and under:
    - .1 Body and cap: cast high tensile bronze to ASTM B62.
    - .2 Pressure rating: 600 WOG.
    - .3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders and solder ends to ANSI B16.18.
    - .4 Stem: tamperproof ball drive.
    - .5 Stem packing nut: external to body.
    - .6 Ball and seat: replaceable stainless steel or hard chrome solid ball and teflon seats.
    - .7 Stem seal: TFE with external packing nut.
    - .8 Operator: removable lever handle.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

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VALVES - BRONZE

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**END OF SECTION**

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.9, Building Service Piping.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563, 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 SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 ANSI/MSS SP69, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

**1.2 SYSTEM DESCRIPTION**

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

**1.3 SUBMITTALS**

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

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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- .3 Structural assemblies.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.4 DELIVERY, STORAGE, AND HANDLING**
- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- Part 2 Products**
- 2.1 GENERAL**
- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- 2.2 PIPE HANGERS**
- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized or painted with zinc-rich paint after manufacture.
  - .2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, to MSS SP69.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.
- .4 Upper attachment to concrete:

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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- .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.
- .5 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.
- .6 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.
- .7 Adjustable clevis: material to MSS SP69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .9 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: black epoxy coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

**2.3 RISER CLAMPS**

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

**2.4 EQUIPMENT SUPPORTS**

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

**2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

**2.6 OTHER EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports from structural grade steel.
- .2 Submit structural calculations with shop drawings.

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts.
- .5 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 National Plumbing Code and authority having jurisdiction.
- .2 Sprinkler piping: to NFPA 13.
- .3 Hydronic piping: to ASME B31.9.

**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.

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HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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**3.5 HORIZONTAL MOVEMENT**

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

**3.6 FINAL ADJUSTMENT**

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

**END OF SECTION**



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VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

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**Part 1            General**

**1.1                SUMMARY**

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

**1.2                REFERENCES**

- .1    National Fire Protection Association (NFPA)
  - .1        NFPA 13, Standard for the Installation of Sprinkler Systems.

**1.3                SUBMITTALS**

- .1    Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1        Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2    Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1        Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2        Instructions: submit manufacturer's installation instructions.
  - .3        Manufacturer's Field Reports: manufacturer's field reports specified.

**Part 2            Products**

**2.1                GENERAL**

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

**2.2                SPRINGS**

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

**2.3                HANGERS**

- .1    Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

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VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

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**2.4 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES**

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

**2.5 HORIZONTAL THRUST RESTRAINT**

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

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

**3.3 FIELD QUALITY CONTROL**

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VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

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**3.4 CLEANING**

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

**END OF SECTION**

MECHANICAL IDENTIFICATION

**Part 1 General**

**1.1 REFERENCES**

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

**Part 2 Products**

**2.1 SUSTAINABLE REQUIREMENTS**

**2.2 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.

**2.3 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, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

Size # mm	Sizes (in)	No. of Lines	Height of Letters (in)
1	3/8 x 2	1	1/8

MECHANICAL IDENTIFICATION

Size # mm	Sizes (in)	No. of Lines	Height of Letters (in)
2	1/2 x 3	1	3/16
3	1/2 x 3	2	1/8
4	3/4 x 4	1	5/16
5	3/4 x 4	2	3/16
6	3/4 x 8	1	5/16
7	1 x 5	1	1/2
8	1 x 5	2	5/16
9	1-3/8 x 8	1	3/4

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment in Mechanical and Electrical Rooms: use size # 5.

.3 Equipment elsewhere: sizes as appropriate.

**2.4 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 Contract Administrator.

**2.5 PIPING SYSTEMS GOVERNED BY CODES**

.1 Identification:

.1 Sprinklers: to NFPA 13.

**2.6 IDENTIFICATION OF PIPING SYSTEMS**

.1 Identify piping systems by City of Winnipeg colour codes specification.

.2 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.3 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.4 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.5 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 3 inches: 4 inches long x 2 inches high.

**MECHANICAL IDENTIFICATION**

- .2 Outside diameter of pipe or insulation 3 inches and greater: 6 inches long x 2 inches high.
- .3 Use double-headed arrows where flow is reversible.
- .6 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .7 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 3/4 inches and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 300°F and intermittent temperature of 400°F.
- .8 Colours and Legends:
  - .1 Where not listed, obtain direction from Contract Administrator.
  - .2 Colours for legends, arrows: to following table:

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

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

Contents	Background colour marking	Legend
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Compressed air	Yellow	COMP. AIR xxx psig
Sprinklers	Red	SPRINKLERS

**2.7 IDENTIFICATION DUCTWORK SYSTEMS**

- .1 2 inches high stencilled letters and directional arrows 6 inches long x 2 inches high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

**2.8 VALVES, CONTROLLERS**

- .1 Brass tags with 1/2 inches 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.

MECHANICAL IDENTIFICATION

**2.9 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.

**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 has been completed.

**3.3 INSTALLATION**

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

**3.4 NAMEPLATES**

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

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

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 50 feet 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.

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MECHANICAL IDENTIFICATION

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- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

**3.6 VALVES, CONTROLLERS**

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

**END OF SECTION**



TESTING, ADJUSTING AND BALANCE FOR HVAC

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**Part 1 General**

**1.1 SUMMARY**

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

**1.2 DEFINITIONS**

- .1 AABC: the Associated Air Balance Council, a nonprofit association of certified, independent test and balance agencies.
- .2 TAB: Testing, adjusting, and balancing
- .3 TAB Agency: An independent entity certified by AABC to perform testing and balancing work
- .4 TBE: AABC certified test and balance engineer
- .5 TBT: AABC certified test and balance technician
- .6 HVAC: Heating, ventilating, and air conditioning

**1.3 QUALITY ASSURANCE**

- .1 Agency Qualifications: Engage an independent T&B agency certified by AABC
  - .1 Supervisor: Employee of the T&B agency who is certified by AABC as a TBE.
  - .2 Technician: Employee of the T&B agency who is certified by AABC as a TBT.
- .2 TBE shall perform the following:
  - .1 Review field data reports to validate accuracy of data and to prepare certified T&B reports.
  - .2 Certify that the T&B team complied with the approved T&B plan and the procedures referenced in this Specification.
  - .3 Certify the T&B report.
- .3 T&B Report Forms: Use approved forms submitted with the Strategies and Procedures Plan.
- .4 Instrumentation Type, Quantity, Accuracy, and Calibration: As described in the AABC National Standards for Total System Balance.

**1.4 SUBMITTALS**

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

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TESTING, ADJUSTING AND BALANCE FOR HVAC

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- .1 Qualifications: The TAB agency shall submit a company resume listing personnel and project experience in air and hydronic system balancing and a copy of the agency's test and balance engineer (TBE) certificate.
- .2 Procedures and Agenda: The TAB agency shall submit the TAB procedures and agenda proposed to be used.
- .3 Sample Forms: The TAB agency shall submit sample forms, which shall include the minimum data required by the AABC National Standards.

**1.5 CONTRACTOR RESPONSIBILITIES**

- .1 Provide T&B agency one complete set of contract documents, change orders, and approved submittals in digital and hard copy formats
- .2 Controls contractor shall provide required BAS hardware, software, personnel and assistance to T&B agency as required to balance the systems. Controls contractor shall also provide trending report to demonstrate that systems are complete.
- .3 Coordinate meetings and assistance from suppliers and contractors as required by T&B agency.
- .4 Provide additional valves, dampers, sheaves and belts as required by T&B agency.
- .5 Flag all manual volume dampers with fluorescent or other high-visibility tape.
- .6 Provide access to all dampers, valves, test ports, nameplates and other appurtenances as required by T&B agency.
- .7 Replace or repair insulation as required by T&B agency.
- .8 Have the HVAC systems at complete operational readiness for T&B to begin. As a minimum verify the following:
  - .1 Airside:
    - .1 All ductwork is complete with all terminals installed.
    - .2 All volume, smoke and fire dampers are open and functional.
    - .3 Clean filters are installed.
    - .4 All fans are operating, free of vibration, and rotating in correct direction.
    - .5 VFD start-up is complete and all safeties are verified.
    - .6 System readiness checklists are completed and returned to T&B agency.
  - .2 Hydronics:
    - .1 Piping is complete with all terminals installed.
    - .2 Water treatment is complete.
    - .3 Systems are flushed, filled and air purged.
    - .4 Strainers are pulled and cleaned.
    - .5 Control valves are functioning per the sequence of operation.
    - .6 All shutoff and balance valves have been verified to be 100% open.
    - .7 Pumps are started, and proper rotation is verified.

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TESTING, ADJUSTING AND BALANCE FOR HVAC

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- .8 Pump gauge connections are installed directly at the pump inlet and outlet flange or in discharge and suction pipe prior to any valves or strainers.
- .9 VFD start-up is complete and all safeties have been verified.
- .10 System readiness checklists are completed and returned to T&B agency.
- .9 Promptly correct deficiencies identified during T&B.
- .10 Maintain a construction schedule that allows the T&B agency to complete work prior to occupancy

**1.6 TAB PREPARATION AND COORDINATION**

- .1 Shop drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB work to be provided to the TAB agency no later than 30 days prior to the start of TAB work.
- .2 System installation and equipment startup shall be complete prior to the TAB agency's being notified to begin.
- .3 The systems control system shall be complete and operational. The Building Control System contractor to assist with reprogramming, coordination and problem resolution.
- .4 All test points, balancing devices, identification tags, etc. shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.
- .5 Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

**1.7 REPORTS**

- .1 Final TAB Report
  - .1 Submit the final TAB report for review by the Contract Administrator. All outlets, devices, HVAC equipment, etc., are to be identified, along with a numbering system corresponding to report unit identification.
  - .2 Submit an AABC "National Project Performance Guaranty" assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and AABC National Standards.

**1.8 DEFICIENCIES**

- .1 Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the Contract Administrator and the Contractor.
- .2 The work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB agency returns to retest. Unresolved deficiencies shall be noted in the final report.

TESTING, ADJUSTING AND BALANCE FOR HVAC

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**Part 2 Products**

**2.1 INSTRUMENTATION**

- .1 All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with the requirements of AABC National Standards.

**Part 3 Execution**

**3.1 GENERAL**

- .1 The specified systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC National Standards. Adjustment tolerances shall be + or - 10% unless otherwise stated.
- .2 Equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be marked to show final settings.
- .3 All information necessary to complete a proper TAB project and report shall be per AABC standards unless otherwise noted. The descriptions for work required, as listed in this section, are a guide to the minimum information needed.

**3.2 PRECONSTRUCTION PLAN CHECK AND REVIEW**

- .1 Review the project documents and contractor submittals for their effect on the TAB process and overall performance of the HVAC system. Submit recommendations for enhancements or changes to the system within 15 days of document review.

**3.3 JOB SITE REVIEW**

- .1 Inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems.
- .2 Inspect when a minimum 75% of the total system is installed.
- .3 Submit a written report of inspection.

**3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- .1 Prepare test reports for both fans and outlets. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- .2 Prepare a single-line schematic diagram of systems for the purpose of identifying HVAC components.

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TESTING, ADJUSTING AND BALANCE FOR HVAC

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- .3 The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set in the full open position. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards
- .4 Supply Fans
  - .1 Fan speeds: Test and adjust fan RPM to achieve maximum or design CFM.
  - .2 Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
  - .3 Pitot-Tube Traverse: Perform a Pitot-tube traverse of main supply and return ducts, as applicable to obtain total CFM.
  - .4 Outside Air Test and adjust the outside air on applicable equipment using a Pitot-tube traverse. If a traverse is not practical use the mixed-air temperature method if the inside and outside temperature difference is at least 20°F or use the difference between Pitot-tube traverses of the supply and return air ducts.
  - .5 Static Pressure: Test and record system static profile of each supply fan.
- .5 Exhaust Fans
  - .1 Fan speeds: Test and adjust fan RPM to achieve maximum or design CFM.
  - .2 Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
  - .3 Pitot-Tube Traverse: Perform a Pitot-tube traverse of main supply and return ducts, as applicable to obtain total CFM.
  - .4 Static Pressure: Test and record system static profile of each exhaust fan.
- .6 Zone, Branch and Main Ducts
  - .1 Adjust ducts to within design CFM requirements. As applicable, at least one zone balancing damper shall be completely open. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.
- .7 Grilles, Registers and Diffusers
  - .1 Tolerances - Test, adjust, and balance each grille, register and diffuser to within 10% of design requirements. Minimize drafts.
  - .2 Identification - Identify the type, location, and size of each grille, register and diffuser. Record information on air outlet data sheets.
- .8 Coils
  - .1 Air Temperature: Once air flows are set to acceptable limits, take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.

**3.5 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

- .1 The TAB agency shall, as applicable, confirm that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; and that all balancing

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TESTING, ADJUSTING AND BALANCE FOR HVAC

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valves (except bypass valves) are set full open. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards.

- .2 Coils
  - .1 Tolerances: Test, adjust, and balance all coils with +/- 10% of design requirements.
  - .2 Verification: Verify the type, location, final pressure drop and GPM of each coil. Record information on coil data sheets.

**3.6 VERIFICATION OF HVAC CONTROLS**

- .1 The TAB agency shall be assisted by the building control systems contractor in verifying the operation and calibration of all HVAC and temperature control systems. The following tests shall be conducted:
  - .1 Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, and other safety devices.
  - .2 Verify that all controlling instruments are calibrated and set for design operating conditions.

**3.7 TEMPERATURE TESTING**

- .1 To verify system control and operation, a series of three temperature tests shall be taken at approximately two hour intervals in each separately controlled zone. The resulting temperatures shall not vary more than 2°F from the thermostat or control setpoint during the tests. Outside temperature and humidity shall also be recorded during the testing periods.

**3.8 FIRE DAMPER TESTING**

- .1 Test fire dampers to confirm the operation.
- .2 Verify that an access door has been installed for each fire damper.
- .3 Open the access door, disconnect the fusible link, and allow the damper to close. Confirm smooth operation and the damper closes completely.
- .4 Reset the damper.

**3.9 TAB REPORT VERIFICATION**

- .1 At the time of final inspection, the TAB agency may be required to recheck, in the presence of the Contract Administrator, specific or random selections of data recorded in the certified report. Points and areas for recheck shall be selected by the Contract Administrator. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck will not exceed 25% of the total number tabulated in the report.

TESTING, ADJUSTING AND BALANCE FOR HVAC

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**END OF SECTION**

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THERMAL INSULATION FOR DUCTING

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**1.1 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .2 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .3 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
  - .4 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .5 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
  - .1 TIAC Code A.6, Flexible unicellular tubular elastomer.
- .4 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings
  - .3 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

**1.2 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.
  - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
  - .1 CRD: Code Round Ductwork,
  - .2 CRF: Code Rectangular Finish.



THERMAL INSULATION FOR DUCTING

**1.3 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.

**1.4 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.

**1.5 QUALIFICATIONS**

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

**1.6 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 FIRE AND SMOKE RATING**

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

**2.2 INSULATION**

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Exposed Rectangular Ducts: Rigid fibrous glass or mineral fibreboard insulation, "K" value maximum 0.25 Btu-in/( hr-ft<sup>2</sup>-°F) at 75°F. Factory applied reinforced aluminum foil vapour barrier for cold ducts. Hot duct service temperature 68°F to 150°F. Cold ducts service temperature -40°F to 150°F.
- .3 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass or mineral fibre insulation, "K" value maximum 0.25 Btu-in/(hr-ft<sup>2</sup>-°F) at 75°F. Factory applied reinforced

**THERMAL INSULATION FOR DUCTING**

aluminum foil vapour barrier for cold ducts Hot duct service temperature 68°F to 150°F.  
Cold ducts service temperature -40°F to 150°F.

**2.3 JACKETS**

- .1 Self-Adhesive Vapor Barrier
  - .1 Shall be used in locations where condensate forms only: process water, chilled building water, external air ducting.
  - .2 Fire retardant, compatible with insulation.
  - .3 Acceptable material: Venture Tape

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

**3.3 DUCTWORK INSULATION SCHEDULE**

<b>Application</b>	<b>Recovery Jacket</b>	<b>Thickness (in)</b>
.1 Rectangular cold and dual temperature supply air ducts	Self Adhesive Vapour Tape	2
.2 Outside air ducts to mixing plenum, heating coil or discharge	Self Adhesive Vapour Tape	2

THERMAL INSULATION FOR DUCTING

<b>Application</b>	<b>Recovery Jacket</b>	<b>Thickness (in)</b>
.3 Exhaust air ducts (10 feet back from wall penetration)	Self Adhesive Vapour Tape	1

**END OF SECTION**

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CLEANING AND START-UP OF PIPING SYSTEMS

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**Part 1            General**

**1.1                REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

**1.2                SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

**1.3                DELIVERY, STORAGE, AND HANDLING**

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

**Part 2            Products**

**2.1                CLEANING SOLUTIONS**

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

**Part 3            Execution**

**3.1                MANUFACTURER'S INSTRUCTIONS**

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

**3.2                CLEANING HYDRONIC STEAM SYSTEMS**

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning procedures:
  - .1 Provide detailed report outlining proposed cleaning procedures at least 2 weeks prior to proposed starting date. Report to include:

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CLEANING AND START-UP OF PIPING SYSTEMS

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- .1 Cleaning procedures, flow rates, elapsed time.
  - .2 Chemicals and concentrations used.
  - .3 Inhibitors and concentrations.
  - .4 Specific requirements for completion of work.
  - .5 Special precautions for protecting piping system materials and components.
  - .6 Complete analysis of water used to ensure water will not damage systems or equipment.
- .3 Conditions at time of cleaning of systems:
- .1 Systems: free from construction debris, dirt and other foreign material.
  - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
  - .3 Strainers: clean prior to initial fill.
  - .4 Install temporary filters on pumps not equipped with permanent filters.
  - .5 Install pressure gauges on strainers to detect plugging.
- .4 Report on Completion of Cleaning:
- .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .5 Hydronic Systems:
- .1 Fill system with water, ensure air is vented from system.
  - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
  - .3 Use water metre to record volume of water in system to +/- 0.5%.
  - .4 Add chemicals under direct supervision of chemical treatment supplier.
  - .5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
  - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
  - .7 Add chemical solution to system.
  - .8 Establish circulation, raise temperature slowly to maximum design, 180°F minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 100°F. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
- .6 Glycol Systems:
- .1 In addition to procedures specified above perform specified procedures.
  - .2 Test to prove concentration will prevent freezing to minus 40°F. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

CLEANING AND START-UP OF PIPING SYSTEMS

**3.3 START-UP OF HYDRONIC SYSTEMS**

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
  - .5 Clean out strainers repeatedly until system is clean.
  - .6 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
  - .7 Repeat with water at design temperature.
  - .8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .9 Bring system up to design temperature and pressure slowly over a 48 hour period.
  - .10 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .11 Adjust pipe supports, hangers, springs as necessary.
  - .12 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
  - .13 Check operation of drain valves.
  - .14 Adjust valve stem packings as systems settle down.
  - .15 Fully open balancing valves (except those that are factory-set).
  - .16 Check operation of over-temperature protection devices on circulating pumps.

**END OF SECTION**

ELECTRIC AND ELECTRONIC CONTROL FOR HVAC

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**Part 1 General**

**1.1 SUBMITTALS**

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

**1.2 CONTROLS - GENERAL**

- .1 DDC controls must be able to interface to MSEA technology on the field device network using either the N2Open or BACnet Protocols.
- .2 No LON protocols are to be accepted.
- .3 Controls contractor to provide commissioning sheets for all points on field devices as well as head end equipment.
- .4 Controls contractor to communicate with equipment provider to ensure proper field point integration as well as controllability of the equipment, if not package controls.
- .5 Controls contractor to supply all drawings/graphics/sequence of operations in both a hard and soft copy. Drawings and graphics to be able to be read and modified by City of Winnipeg Staff. User interface graphics to be completed using *Graphic Generation Tool* software. Contractor to supply As-Built drawings in an editable format, able to be easily edited by City of Winnipeg Staff.
- .6 The use of either N2Open or BACnet to be determined based on type of building where the work is being performed. If the construction is a brand new facility, then BACnet can be used. The term BACnet should then be defined properly in its use, see note 1 below. If the work is an addition to and the new work is to be tied into the existing controls, then the contractor should contact City of Winnipeg technical staff to determine the best protocol to use based on existing equipment.
- .7 If other vendor (non-JCI) controls are to be used then a seamless integration must be proven before approval will be given.
- .8 All monitored points that have alarms must have operating instructions and alarm messages. These will be co-ordinated with the tech shop and operations supervisor.

**Part 2 Products**

**2.1 THERMOSTAT (LINE VOLTAGE-HEATING AND COOLING)**

- .1 Line voltage, wall-mounted thermostat, for heating or cooling with:
  - .1 Full load rating: 16A at 120V.
  - .2 Temperature setting range: 40°F to 90°F.

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ELECTRIC AND ELECTRONIC CONTROL FOR HVAC

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- .3 Thermometer range: 40°F to 90°F.
- .4 Markings in 5°F increments.
- .5 Differential temperature fixed at 2°F.

**2.2 THERMOSTAT (LOW VOLTAGE)**

- .1 Low voltage wall thermostat:
  - .1 For use on 24 V circuit at 1.5 A capacity.
  - .2 Temperature setting range: 10°C to 25°C.

**2.3 MONITORING**

- .1 The following systems shall be monitored back to the existing BAS:
  - .1 Electrical room zone temperature (analog input). Also program a low temperature alarm set for 5°C and a high temperature alarm set for 38°C in the BAS.
  - .2 Sump pump high level alarm (discrete input). Provide a pill switch in the sump for this alarm.
  - .3 Main Power status (discrete input) off of the customer digital metering system. Provide alarm in the BAS if the main power is off.

**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 control devices.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25mm from exterior wall.

**END OF SECTION**



HYDRONIC SYSTEMS - STEEL

**Part 1 General**

**1.1 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME B16.3, Malleable Iron Threaded Fittings.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
  - .5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6 ASTM E202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .3 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

**1.2 SUBMITTALS**

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

**Part 2 Products**

**2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 NPS2 and under: Schedule 40.

**2.2 PIPE JOINTS**

- .1 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.
- .2 Pipe thread: taper.

**2.3 FITTINGS**

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

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HYDRONIC SYSTEMS - STEEL

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**2.4 VALVES**

- .1 Connections:
  - .1 NPS2 and smaller: screwed ends.
- .2 Balancing, for TAB:
  - .1 Sizes: Calibrated balancing valves, as specified this section.
    - .1 NPS2 and under: Globe, with plug disc as specified Section 23 05 22 - Valves - Bronze.
- .3 Drain valves: ball, as specified Section 23 05 22 - Valves - Bronze.
- .4 Swing check valves: as specified Section 23 05 22 - Valves - Bronze.
- .5 Silent check valves: as specified Section 23 05 22 - Valves - Bronze.
- .6 Ball valves: as specified Section 23 05 22 - Valves - Bronze.

**Part 3 Execution**

**3.1 PIPING INSTALLATION**

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

**3.2 CLEANING, FLUSHING AND START-UP**

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

**3.3 TESTING**

- .1 Test system in accordance with Section 21 05 01 - Common Work Results - Mechanical.
- .2 For glycol systems, retest glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

**3.4 BALANCING**

- .1 Balance water systems to within plus or minus 5% of design output.
- .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

**3.5 GLYCOL CHARGING**

- .1 Provide mixing tank and positive displacement pump for glycol charging.
- .2 Retest for concentration to ASTM E202 after cleaning.

HYDRONIC SYSTEMS - STEEL

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**END OF SECTION**

METAL DUCTS LOW PRESSURE TO 500 PA

**Part 1 General**

**1.1 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA).
  - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition and Addendum No. 1.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1st Edition.

**1.2 SUBMITTALS**

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

**Part 2 Products**

**2.1 SEAL CLASSIFICATION**

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

**2.2 SEALANT**

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of -30°C to 93°C.
- .2 Acceptable material: Duro-Dyne, 3M, Flexa-Duct, United, Bakelite

**2.3 TAPE**

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

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METAL DUCTS LOW PRESSURE TO 500 PA

**2.4 DUCT LEAKAGE**

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

**2.5 FITTINGS**

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
  - .1 Centreline radius: 0.6 times width of duct.
- .3 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .4 Fire stopping material and installation must not distort duct.

**2.6 GALVANIZED STEEL**

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

**2.7 HANGERS AND SUPPORTS**

- .1 Hangers and Supports:
  - .1 Hanger configuration: to SMACNA.
  - .2 Hangers: galvanized steel angle with galvanized steel rods to SMACNA and the following table:

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

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

**Part 3 Execution**

**3.1 GENERAL**

- .1 Do work in accordance with SMACNA.

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METAL DUCTS LOW PRESSURE TO 500 PA

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- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA.

**3.2 HANGERS**

- .1 Hanger spacing: in accordance with SMACNA.

**3.3 WATERTIGHT DUCT**

- .1 Provide watertight duct for:
  - .1 Outdoor air intake.
- .2 Form bottom of horizontal duct without longitudinal seams.
  - .1 Solder or weld joints of bottom and side sheets.
  - .2 Seal other joints with duct sealer.
- .3 Slope header ducts down toward risers.
- .4 Fit base of riser with 150 mm deep drain sump and 19 mm drain connected, with deep seal trap and valve 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**

AIR DUCT ACCESSORIES

**Part 1 General**

**1.1 REFERENCES**

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

**1.2 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Instrument test ports.

**Part 2 Products**

**2.1 GENERAL**

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

**2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame 24 gauge with fabric clenched by means of double locked seams.
- .2 Material: Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at -40°F to 195°F, density of 0.21 lbs/ft<sup>2</sup>.

**2.3 ACCESS DOORS IN DUCTS**

- .1 Construction: sandwich construction of same material as duct, hardware and metal thickness to table below. For insulated duct installations provide 25 mm thick rigid fibre insulation in door.

Door Size	No. of Hinges	No. of Sash Locks	Metal Thickness		
			Frame	Door	Back
300 x 300	2	1-S	0.6	0.6	0.5
400 x 500	2	1-S	0.8	0.6	0.5
600 x 600	3	2-S	0.8	0.8	0.5

AIR DUCT ACCESSORIES

S = Side opposite hinges

- .2 Gaskets: neoprene or foam rubber.

**2.4 INSTRUMENT TEST PORTS**

- .1 Zinc alloy casting with a neoprene backing gasket. Fastened to duct wall with no. 10 x ½ drill screw or no. SS-66 pin rivet.
- .2 Access port: 3/4 inch in diameter removable using a standard screwdriver.
- .3 Acceptable material: Duro-Dyne model IP-4

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
  - .2 Length of connection: 4 inches.
  - .3 Minimum distance between metal parts when system in operation: 3 inches.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
  - .1 Size:
    - .1 12 x 12 inches for servicing entry.
    - .2 As indicated
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat and cooling coils.
    - .6 Elsewhere as indicated.



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AIR DUCT ACCESSORIES

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- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA, ASHRAE, in accordance with manufacturer's instructions and in coordinated with the TAB Subcontractor.
    - .2 Locate to permit easy manipulation of instruments.
    - .3 Install insulation port extensions as required.
    - .4 Locations:
      - .1 For traverse readings:
        - .1 Ducted inlets to roof and wall exhausters.
        - .2 Inlets and outlets of other fan systems.
        - .3 Main and sub-main ducts.
        - .4 And as indicated.
      - .2 For temperature readings:
        - .1 At outside air intakes.
        - .2 In mixed air applications in locations as approved by Contract Administrator.
        - .3 At inlet and outlet of coils.
        - .4 Downstream of junctions of two converging air streams of different temperatures.
        - .5 And as indicated.

**END OF SECTION**

**DAMPERS - BALANCING**

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**Part 1 General**

**1.1 REFERENCES**

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

**Part 2 Products**

**2.1 GENERAL**

- .1 Manufacture to SMACNA standards.

**2.2 SINGLE BLADE DAMPERS**

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

**2.3 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 4 inches.
- .4 Bearings: pin in bronze bushings or self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install in accordance with recommendations of SMACNA.
- .2 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

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DAMPERS - BALANCING

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- .3 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .4 Ensure damper operators are observable and accessible.

**END OF SECTION**

DAMPERS - OPERATING

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**Part 1 General**

**1.1 REFERENCES**

- .1 Air Movement and Control Association International Inc. (AMCA)
  - .1 AMCA Publication 511, Certified Ratings Program – Product Rating Manual for Air Control Devices.
  - .2 AMCA Standard 500-D, Laboratory Methods of Testing Dampers for Rating

**1.2 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, materials of construction and limitations.

**1.3 QUALITY ASSURANCE**

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

**Part 2 Products**

**2.1 MULTI-LEAF DAMPERS**

- .1 Frames: 4 inch deep x 0.081 inch in thickness, mill finish extruded aluminum (6063T5) with mounting flanges on both sides of frame. Frame to be assembled using plated steel mounting fasteners. Entire frame shall be thermally broken by means of two polyurethane resin pockets, complete with thermal cuts.
- .2 Blade: extruded aluminum (T6063T5), 0.063 inches thick, mill finish, 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.
- .3 Blade and Frame Seals: flexible extruded Santoprene 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.
- .4 Bearings: Acetal inner bearing fixed to a 0.375 inch extruded aluminum blade axel, rotating within a polycarbonate outer bearing inserted into the frame.
- .5 Linkage hardware: installed in the frame side. All linkage crank arm and rod hardware parts shall be constructed of mill finished aluminum, complete with corrosion resistant, zinc-plated trunnions and cup-point trunnion screws for a slip-proof grip.
- .6 Operating temperature range: -40°F to 160°F.
- .7 Leakage: 3 cfm/ft<sup>2</sup> at 4 in.w.g. differential static pressure for a 36 inch x 36 inch damper. Standard air leakage data shall be certified under the AMCA Certified Ratings Program.

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DAMPERS - OPERATING

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- .8 Dampers shall be made to size required without blanking off free area.
- .9 Blade Action: Opposed blade for volume control and parallel blade for mixing control.
- .10 Mounting: Flanged mounting type.
- .11 Operator: to Section 23 09 33 – Electric and Electronic Control System for HVAC.
- .12 Acceptable material: Alumavent model 3965BF

**2.2 BACK DRAFT DAMPERS**

- .1 Frames: 2.75 inches deep and no less than 0.06 inches thick, mill finish extruded aluminum (6063-T5) with mounting flanges on both sides of frame. Frame to be assembled using plated steel mounting fasteners.
- .2 Blades: extruded aluminum (6063-T5) profiles and not less than 0.06 inches in thickness.
- .3 Blade and frame seals: shall be of extruded vinyl and shall be secured in an integral slot within the aluminum extrusions.
- .4 Operating temperature range: -40°F to 160°F.
- .5 Pressure drop (exhaust): 0.3 inches w.g at 100 fpm, for a 24 inch x 24 inch damper in the open position.
- .6 Acceptable material: Alumavent model BDD-DM

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

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

**END OF SECTION**

**DAMPERS – FIRE AND SMOKE**

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**Part 1 General**

**1.1 SUMMARY**

**1.2 REFERENCES**

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

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .2 Indicate the following:
    - .1 Fire dampers.
    - .2 Fusible links.
    - .3 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals: Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.4 QUALITY ASSURANCE**

- .1 Certificates: 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.

**DAMPERS – FIRE AND SMOKE**

**Part 2 Products**

**2.1 FIRE DAMPERS**

- .1 Fire dampers: arrangement Type B or C, listed and bear label of ULC, meet requirements of the Manitoba Fire Commissioner, ANSI/NFPA 90A and authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
  - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Construction: dynamic, round or square; curtain 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 1-1/2 x 1-1/2 x 1/8 inch 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.
- .11 Acceptable material: Nailor, Ruskin, E.H. Price, NCA

**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.

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DAMPERS – FIRE AND SMOKE

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**3.2           INSTALLATION**

- .1       Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2       Maintain integrity of fire separation.
- .3       After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4       Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .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.

**END OF SECTION**



HVAC FANS

**Part 1 General**

**1.1 REFERENCES**

- .1 Air Conditioning and Mechanical Contractors (AMCA)
  - .1 AMCA Publication 99, Standards Handbook.
  - .2 AMCA Standard 204, Balance Quality and Vibration Levels for Fans
  - .3 AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .4 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
  - .5 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

**1.2 SYSTEM DESCRIPTION**

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

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .2 Provide :
    - .1 Fan performance curves showing point of operation, BHP and efficiency.
    - .2 Sound rating data at point of operation.
  - .3 Indicate:
    - .1 Motors, sheaves, bearings, shaft details.
    - .2 Materials of construction.
- .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.

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HVAC FANS

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- .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**Part 2 Products**

**2.1 FANS GENERAL**

- .1 Motors:
  - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
  - .2 For use with variable speed controllers.
  - .3 Sizes as indicated.
- .2 Accessories and hardware: belt guards
- .3 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .4 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .5 Flexible connections: to Section 23 33 00 - Air Duct Accessories.
- .6 Acceptable manufacturers: Loren Cook, Greenheck, PennBarry.

**2.2 WALL MOUNTED CENTRIFUGAL FANS**

- .1 General: Spun aluminum, wall mounted, direct driven, horizontal centrifugal exhaust ventilator.
- .2 Housing: Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The spun aluminum wall flange shall have prepunched keyslot holes and a mounting template with wall opening location for ease of installation. The windband shall have a rolled bead for added strength. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM and static pressure. Unit shall be shipped in ISTA certified transit tested packaging.
- .3 Wheel: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

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HVAC FANS

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- .4 Motor: Motor shall be heavy duty type with permanently lubricated sealed bearings and furnished at the specified voltage, phase and enclosure.

**2.3 IN LINE CENTRIFUGAL FANS**

- .1 General: Duct mounted, belt driven centrifugal square inline fan.
- .2 Housing: 18 gauge galvanized steel housing with integral duct collars. Bolted access doors on three sides, sealed with closed cell neoprene gasketing. Corrosion resistant bolted fasteners. Pivoting motor plate to provide positive belt tensioning. Universal mounting feet for horizontal or vertical installation.
- .3 Wheel: Centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Balanced in accordance with AMCA Standard 204.
- .4 Motor: NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.
- .5 Bearings: Designed and individually tested specifically for use in air handling applications. Heavy duty regreasable ball type in a pillowblock cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- .6 Belts: Oil and heat resistant, static conducting.
- .7 Drives: Precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Sized for 150 percent of the installed motor horsepower. The variable pitch motor drive factory set to the specified fan RPM.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 FAN INSTALLATION**

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

HVAC FANS

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**END OF SECTION**

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DIFFUSERS, REGISTERS AND GRILLES

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**Part 1            General**

**1.1                SYSTEM DESCRIPTION**

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

**1.2                SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures]. Include product characteristics, performance criteria, and limitations.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.

**1.3                DELIVERY, STORAGE, AND HANDLING**

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

**Part 2            Products**

**2.1                GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
  - .1 Full perimeter gaskets.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as indicated.
- .5 Acceptable manufacturers: Nailor, E.H. Price, Titus

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DIFFUSERS, REGISTERS AND GRILLES

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**2.2 MANUFACTURED UNITS**

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

**2.3 SUPPLY GRILLES AND REGISTERS**

- .1 **SA-A:** steel, 1 inch border, double deflection with blades 3/4 inches on centre, front set of blades parallel to short dimension. Finish: aluminum powder coat.

**2.4 RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1 **EA-A:** steel, 1 inch border, single 45° deflection with blades 3/4 inches on centre, horizontal face bars. Finish: aluminum powder coat.

**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 manufacturer's instructions.
- .2 Install with oval head screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place

**END OF SECTION**

LOUVERS, INTAKES AND VENTS

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
  - .1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

**1.2 SYSTEM DESCRIPTION**

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

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate following:
    - .1 Pressure drop.
    - .2 Face area.
    - .3 Free area.
    - .4 Materials of construction.
    - .5 Finishes: colour chips for selection.

**1.4 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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LOUVERS, INTAKES AND VENTS

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**Part 2 Products**

**2.1 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade.
- .4 Frame, head, sill and jamb: 4 inches deep one piece extruded aluminum.
- .5 Screen: 3/4 inch aluminum birdscreen on inside face of louvres in formed U-frame.
- .6 Finish: anodized. Colour: to Contract Administrator's approval.
- .7 Acceptable material: Ventex 2435.

**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 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

**END OF SECTION**



DUCTLESS SPLIT-SYSTEM AIR-CONDITIONERS

**Part 1 General**

**1.1 REFERENCES**

- .1 Air-Conditioning and Refrigeration Institute (ARI)
  - .1 ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .2 ARI 270 - Sound Rating of Outdoor Unitary Equipment.
  - .3 ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
  - .4 ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for units. Include:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Cabinet material thicknesses.
  - .7 Limitations.
  - .8 Colour and finish.

**1.3 CLOSEOUT SUBMITTALS**

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

**Part 2 Products**

**2.1 SPLIT SYSTEM AIR CONDITIONING UNITS**

- .1 Product Description: Split system consisting of fan coil unit and condensing unit including cabinet, evaporator fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, air filters, controls, air handling unit accessories, condensing unit accessories, and refrigeration specialties.
- .2 Acceptable manufacturers:
  - .1 Daikan, Mitsubishi, Sanyo.
- .3 Refrigerants: R401A and R407C.

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DUCTLESS SPLIT-SYSTEM AIR-CONDITIONERS

**2.2 FAN COIL UNIT**

- .1 Cabinet:
  - .1 Panels: Constructed of galvanized steel with baked enamel finish. Access Panels: Located on both sides of unit. Furnish with duct collars on inlets and outlets.
  - .2 Insulation: Factory applied to each surface to insulate entire cabinet. One inch thick neoprene coated aluminum foil faced glass fiber with edges protected from erosion.
- .2 Evaporator Fan: Forward curved centrifugal type, resiliently mounted with adjustable belt drive and high efficiency motor. Motor permanently lubricated with built-in thermal overload protection.
- .3 Evaporator Coil: Constructed of copper tubes expanded onto copper fins. Factory leak tested under water. Removable, PVC construction, double-sloped stainless steel drain pan with piping connections on both sides. Coil shall be coated with minimum 1.0 mil. aluminum impregnated polyurethane coating by Blygold PoluAl XT or approved equal. Coating shall withstand 4,000 hours in both salt spray test per ASTM B117 and acid salt spray test per ASTM D5339.
- .4 Refrigeration System: Single or Dual refrigeration circuits controlled by factory installed thermal expansion valve. Refrigerant shall be R407C or R410A.
- .5 Air Filters: 1 inch thick glass fiber disposable media in metal frames. 25 to 30 percent efficiency based on ASHRAE 52.1.
- .6 Unit shall be wall mounted, ceiling mounted, or ceiling cassette type (integral with grid).

**2.3 CONDENSING UNIT**

- .1 General: Factory assembled and tested air cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls.
- .2 Unit Casings: Exposed casing surfaces constructed of galvanized steel with manufacturer's standard baked enamel finish. Designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives.
- .3 Compressor: Single refrigeration circuit or two independent refrigeration circuits with rotary or hermetic semi-hermetic reciprocating type compressors, resiliently mounted, with positive lubrication, and internal motor overload protection. Compressor shall five (5) year warranty.
- .4 Condenser Coil: Constructed of copper tubing mechanically bonded to copper fins, factory leak and pressure tested. Coil shall be coated with minimum 1.0 mil. aluminum impregnated polyurethane coating by Blygold PoluAl XT or approved equal. Coating shall withstand 4,000 hours in both salt spray test per ASTM B117 and acid salt spray test per ASTM D5339.

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DUCTLESS SPLIT-SYSTEM AIR-CONDITIONERS

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- .5 Controls: Furnish operating and safety controls including high and low pressure cutouts. Control transformer. Furnish magnetic contactors for compressor and condenser fan motors.
- .6 Condenser Fans and Drives: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Permanently lubricated ball bearing type motors with built-in thermal overload protection. Furnish high efficiency fan motors.
- .7 Condensing Unit Accessories: Furnish the following accessories:
  - .1 Controls to provide low ambient cooling to 0°F.
  - .2 Time delay relay.
  - .3 Anti-short cycle timer.
  - .4 Disconnect switch.
  - .5 Vibration isolators.
  - .6 Hot gas bypass kit.
  - .7 Coil with corrosion resistant coating capable of withstanding salt spray test of 1000 hours in accordance with ASTM B117.
  - .8 Condenser Coil Guard: Condenser fan openings furnished with PVC coated steel wire safety guards.
  - .9 Suction and discharge pressure gauges.
- .8 Refrigeration specialties: Furnish the following for each circuit:
  - .1 Charge of compressor oil.
  - .2 Holding charge of refrigerant.
  - .3 Replaceable core type filter drier.
  - .4 Liquid line sight glass and moisture indicator.
  - .5 Shut-off valves on suction and liquid piping.
  - .6 Liquid line solenoid valve.
  - .7 Charging valve.
  - .8 Oil level sight glass.
  - .9 Crankcase heater.
  - .10 Hot gas muffler.
  - .11 Pressure relief device.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install per manufacturer's recommendations.
- .2 Mount fan coil unit on wall as indicated.
- .3 Provide knee brace brackets for mounting the condensing unit on the outside wall. Provide 2" deflection spring vibration isolators.

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DUCTLESS SPLIT-SYSTEM AIR-CONDITIONERS

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- .4 Install condensate piping with trap and route from drain pan to nearest floor drain.

**END OF SECTION**

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UNIT HEATERS

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**Part 1            General**

**1.1                PRODUCT DATA**

- .1        Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Submit product data sheets for unit heaters. Include:
  - .1        Product characteristics.
  - .2        Performance criteria.
  - .3        Mounting methods.
  - .4        Physical size.
  - .5        kW rating, voltage, phase.
  - .6        Cabinet material thicknesses.
  - .7        Limitations.
  - .8        Colour and finish.
- .3        Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, and cleaning procedures.

**1.2                SHOP DRAWINGS**

- .1        Indicate:
  - .1        Equipment, capacity and piping connections.
  - .2        Dimensions, internal and external construction details, recommended method of installation with proposed support, sizes and location of mounting bolt holes.

**1.3                CLOSEOUT SUBMITTALS**

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

**Part 2            Products**

**2.1                CABINET UNIT HEATERS**

- .1        Cabinet: type surface, 16 gauge steel with removable panels and integral air outlet and inlet.
- .2        Finish: factory applied epoxy powder.
- .3        Coils: aluminum fins mechanically bonded to 1/2 inch seamless copper tubes with a maximum working pressure 300 psig. Each coil is supplied with a manual air vent.
- .4        Fans: forward curved, centrifugal double width wheels, fabricated from galvanized steel, direct driven, sleeve bearings, resilient mounted.

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UNIT HEATERS

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- .5 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.
- .6 Filters: removable one (1) inch mm thick fibrous glass throwaway type.
- .7 Electrical: primary internal wiring and tested at the factory.
- .8 Units to comply with UL1995 and CSA C22.2 and be ETL certified.
- .9 Capacity: as indicated in schedules.
- .10 Acceptable manufacturer: Rittling

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide double swing pipe joints as indicated.
- .3 Check final location with Contract Administrator if different from that indicated prior to installation.
  - .1 Should deviations beyond allowable clearances arise, request and follow Contract Administrator's directive.
- .4 Hot water units: for each unit, install ball valve on inlet and calibrated balancing valve on outlet of each unit. Install drain valve at low point and manual air vent at high point.
- .5 Clean finned tubes and comb straight.
- .6 Provide supplementary suspension steel as required.
- .7 Install thermostats in locations indicated.
- .8 Before acceptance, set discharge patterns and fan speeds to suit requirements.

**END OF SECTION**

UNIT HEATERS - ELECTRIC

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.46, Electric Air-Heaters.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for unit heaters. Include:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Cabinet material thicknesses.
  - .7 Limitations.
  - .8 Colour and finish.
- .3 Submit product data sheets for unit heaters.
  - .1 Include product characteristics, performance criteria, physical size, limitations and finish.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for unit heaters for incorporation into O&M manual.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Collect, package and store existing unit heaters for either reinstallation or recycling.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Acceptable manufacturers:
  - .1 Ouellet, Chromalox.

**2.2 UNIT HEATERS**

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.

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UNIT HEATERS - ELECTRIC

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- .2 Fan type unit heaters with built-in high-heat limit protection.
- .3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.
  - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: Threaded rod.
- .5 Elements: Tubular stainless steel.
- .6 Cabinet: steel, 18 and 20 gauge.
- .7 Finish: Epoxy/polyester powder paint.
- .8 Performance: 5kW, 600V/3ph/60hz, 700 cfm, 1/30 hp motor, 1550 rpm, 240/208V motor.

**2.3 CONTROLS**

- .1 Wall mounted thermostats: 120V line voltage, to Section 23 09 33 - Electric and Electronic Control System for HVAC.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Suspend unit heater from ceiling or mount on wall as indicated.
- .2 Install thermostat in location indicated.
- .3 Make power and control connections.

**3.2 FIELD QUALITY CONTROL**

- .1 Test cut-out protection when air movement is obstructed.
- .2 Test fan delay switch to assure dissipation of heat after element shut down.
- .3 Test unit cut-off when fan motor overload protection has operated.
- .4 Ensure heater and controls operate correctly.

**END OF SECTION**