

1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Points of operation on performance curves.
 - .3 Manufacturer to certify current model production.
 - .4 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative
 - .2 Make changes as required and re-submit as directed by Departmental Representative

- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for in accordance with Section 01 74 22 - Construction/Demolition Waste Management and Disposal.

2 Products N/A

3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

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

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

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

3.5 PROTECTION

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

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .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.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .4 Closeout Submittals
 - .1 Provide maintenance data for motors, drives and guards 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.

2 Products

2.1 GENERAL

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

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, ___600___ V, unless otherwise indicated.

2.3 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.4 DRIVE GUARDS

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

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.
- .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 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified wood.
 - .8 Low-emitting materials.

3.4 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

1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Fold up metal banding, flatten and place in designated area for recycling.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- .4 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

2 Products

2.1 GENERAL

- .1 Design point to be at midpoint of scale or range.
- .2 Ranges:
 - .1 Water and Glycol Thermometers: 0 to 115° C, 30° to 240° F.
 - .2 Pressure Gauges:
 - .1 Hydronic 0-400 kPa, 0 to 60 psi.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4 ASME B40.200.

2.3 THERMOMETER WELLS

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

2.4 PRESSURE GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
 - .1 Siphon for steam service.
 - .2 Snubber for pulsating operation.
 - .3 Diaphragm assembly for corrosive service.
 - .4 Gasketed pressure relief back with solid front.
 - .5 Bronze stop cock.

3 Execution

3.1 GENERAL

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

3.2 THERMOMETERS

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
 - .1 Water heating and cooling coils.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in following locations:
 - .1 Suction and discharge of pumps.
 - .2 Upstream and downstream of control valves.
 - .3 Inlet and outlet of coils.
 - .4 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

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

END OF SECTION

1 General

1.1 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 ASTM International
 - .1 ASTM A 276, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 283, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B 505/B 505M, Standard 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .3 Shop Drawings:
 - .1 Submit data for valves specified in this Section.

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

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

2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 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.
 - .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.
 - .3 NPS 2 and under, swing type, bronze disc:
 - .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 NPS 2 and under, swing type, composition disc, Class 200:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
 - .5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
 - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
 - .2 Disc: renewable PTFE no. 6 composition rotating disc in disc holder having guides top and bottom, of bronze to ASTM B 62.
 - .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
 - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .4 Lead Free Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class125.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders solder ends to ANSI.

- .4 Stem: tamperproof ball drive.
- .5 Stem packing nut: external to body.
- .6 Ball and seat: replaceable stainless steel hard chrome solid ball and Teflon seats.
- .7 Stem seal: TFE with external packing nut.
- .8 Operator: removable lever handle.

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.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International Inc.
 - .1 ASTM A 49, Standard Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A 126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM A 536, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM B 85/B 85M, Standard Specification for Aluminum-Alloy Die Castings.
 - .7 ASTM B 209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-61, Pressure Testing of Steel Valves.
 - .2 MSS SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP-82, Valve Pressure Testing Methods.
 - .5 MSS SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

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

2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.

- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.

- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B 209 Class B ductile iron to ASTM A 536 Grade 65-45-12.
 - .2 Connections: flanged ends plain face with 2 mm raised face with serrated finish grooved ends to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: die-cast aluminum alloy to ASTM B 85/B 85M or malleable iron to ASTM A 49. Nut of bronze to ASTM B 62.
 - .9 Identification tag: with catalogue number, size, other pertinent data.

- .4 All products to have CRN registration numbers.

2.2 GATE VALVES

- .1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B 62.
 - .3 Seat rings: renewable bronze to ASTM B 62, screwed into body.
 - .4 Stem: bronze to ASTM B 62.
 - .5 Disc: solid offset taper wedge, cast iron to ASTM A 126 Class B, secured to wrought steel stem.
 - .6 Seat: integral with body.
 - .7 Stem: wrought steel.
 - .8 Operator: handwheel.

- .2 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B 62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
 - .3 Seat rings: renewable bronze screwed into body.
 - .4 Stem: nickel-plated steel manganese-bronze.
 - .5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
 - .6 Seat rings: integral with body.
 - .7 Stem: nickel-plated steel.

- .8 Pressure-lubricated operating mechanism.
- .9 Operator: handwheel
- .10 Bypass: complete with union and NPS gate globe valve as Section 23 05 05 - Installation of Pipework, paragraph.

2.3 CHECK VALVES

- .1 Swing check valves, Class 125:
 - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A 126 Class B ductile iron ASTM A 536 Grade 65-45-12.
 - .2 NPS 18 and over: cast iron to ASTM A 126 Class C.
 - .2 Ratings:
 - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
 - .2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.
 - .3 NPS 18 and over: 1.03 MPa CWP.
 - .3 Disc: rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B 62 stainless steel type 316.
 - .2 NPS 8 and over: bronze-faced cast iron.
 - .4 Seat rings: renewable bronze to ASTM B 62 screwed into body.
 - .5 Hinge pin, bushings: renewable bronze to ASTM B 62 stainless steel.
 - .6 Disc: A126 Class B, secured to stem, rotating for extended life.
 - .7 Seat: cast iron, integral with body.
 - .8 Hinge pin: malleable iron.
 - .9 Identification tag: fastened to cover.

2.4 SILENT CHECK VALVES

- .1 Construction:
 - .1 Body: malleable or ductile iron with integral seat.
 - .2 Pressure rating: Class 125, WP = 860 kPa.
 - .3 Connections: grooved ends.
 - .4 Disc: bronze or stainless steel renewable rotating disc.
 - .5 Seat: renewable, EPDM.
 - .6 Stainless steel spring, heavy duty.

3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ASME B1.20.1, Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25,125 and 250.
 - .3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS ½ through 24.
 - .4 ANSI/ASME B16.11, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25, Buttwelding Ends.
 - .6 ANSI/ASME B16.34, Valves - Flanged, Threaded and Welding Ends.
- .2 ASTM International Inc.
 - .1 ASTM A 126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM A 536, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .4 ASTM B 209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate Metric.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-67, Butterfly Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

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

2 Products

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG

- .1 Except to specialty valves, to be of single manufacturer.

- .2 To be suitable for dead-end service.
- .3 CRN registration number required for products.
- .4 Sizes:
 - .1 Lug Wafer type: NPS 2 to 30.
 - .2 Grooved end type: NPS 2 to 12.
- .5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
 - .1 NPS 2 - 12: 200 psig.
- .6 Minimum seat temperature ratings to 121 degrees C.
- .7 Application: on-off operation.
- .8 Full lug body (threaded) Grooved ends.
- .9 Operators:
 - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black laquer.
- .10 Designed to comply with MSS SP-67 and API 609.
- .11 Compatible with ANSI Class 125/Class 150 flanges.
- .12 Construction:
 - .1 Body ductile iron
 - .2 Disc: aluminum bronze
 - .3 Seat: EPDM
 - .4 Shaft: 316 stainless steel.
 - .5 Taper pin: 316 SS.
 - .6 Key: carbon steel stainless.
 - .7 O-Ring:EPDM.

3 Execution

3.1 PREPARATION

- .1 Valve and mating flange preparation.
 - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
 - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
 - .3 Install butterfly valves with disc in almost closed position.
 - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 INSTALLATION OF VALVES

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.
- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

3.3 ACTUATOR INSTALLATION

- .1 Air hoses or electrical connections to be made by actuator manufacturer.
- .2 Cycle valve operation from fully closed to fully open then back to fully closed.
- .3 At same time, check travel stop settings for proper disc alignment.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.

END OF SECTION

1 General

1.1 AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 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 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 Products

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

2.2 GENERAL

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

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
 - .2 Use electro-plating galvanizing process hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed 13 mm FM approved.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed FM approved to MSS-SP 58 and MSS-SP 69 .
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved to MSS SP 69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed FM approved.

- .4 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .5 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel black galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
- .6 Adjustable clevis: material to MSS SP 69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .7 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
 - .1 Finishes for steel pipework: black galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black galvanized, with formed portion plastic coated epoxy coated.
- .8 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP 58, type 42, UL listed FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.5 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.7 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel.

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 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.
- .3 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .5 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.

3.3 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code of Canada
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Within 300 mm of each elbow:

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m

3.4 HANGER INSTALLATION

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

3.5 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.

- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.

- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.6 CLEANING

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

END OF SECTION

1 General

1.1 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.2 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

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

2.2 SYSTEM NAMEPLATES

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

.3 Sizes:

.1 Conform to following table:

Size # (mm)	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

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

.4 Locations:

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

.5 Identification for PWGSC Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #5.

.3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.12 Sprinklers: to NFPA 13.

2.5 IDENTIFICATION OF PIPING SYSTEMS

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

.2 Pictograms:

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

- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.

- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.

- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative DCC Representative Consultant.
 - .2 Colours for legends, arrows: to following table:

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

<u>Contents</u>	<u>Background colour</u>	<u>Legend Marking</u>
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT

2.6 IDENTIFICATION DUCTWORK SYSTEMS

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

2.7 CONTROLS COMPONENTS IDENTIFICATION

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

2.8 LANGUAGE

- .1 Identification in English

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 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 Identify systems, equipment to conform to PWGSC PMSS.

3.3 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.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, 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.

3.5 CLEANING

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

END OF SECTION

1 General

1.1 SUMMARY

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

1.2 QUALIFICATIONS OF TAB PERSONNEL

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

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

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

1.5 CO-ORDINATION

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

1.6 PRE-TAB REVIEW

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

1.7 START-UP

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

1.8 OPERATION OF SYSTEMS DURING TAB

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

1.9 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:

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

1.10 APPLICATION TOLERANCES

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

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 PRELIMINARY TAB REPORT

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

1.14 TAB REPORT

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.15 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.16 SETTINGS

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

1.17 COMPLETION OF TAB

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

1.18 AIR SYSTEMS

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC.
- .2 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

- .3 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.

 - .4 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).
- 2 Products N/A**
- 3 Execution N/A**

END OF SECTION

1 General

1.1 REFERENCES

- .1 Definitions:
 - .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRF: Code Rectangular Finish.
- .2 Reference Standards:
 - .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 ASTM International Inc.
 - .1 ASTM B 209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C 612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .4 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .5 ASTM C 921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
 - .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.

- .2 Details of operation, servicing and maintenance.
- .3 Recommended spare parts list.

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE AND HANDLING

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

2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

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

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: compatible with insulation.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.

- .3 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .4 Tape: self-adhesive, 50 wide minimum.
- .5 Contact adhesive: quick-setting
- .6 Canvas adhesive: washable.
- .7 Tie wire: 1.5 mm stainless steel.

3 Execution

3.1 APPLICATION

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

3.2 PRE-INSTALLATION REQUIREMENTS

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

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .4 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .5 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Outside air Ducts to Units	C-1	yes	50

3.5 CLEANING

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

1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B 209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C 335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 533, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C 547, Mineral Fiber Pipe Insulation.
 - .7 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.

- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
 - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative DCC Representative Consultant.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative DCC Representative Consultant.

2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.
- .4 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.
- .5 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: to ASTM C 533.
 - .2 Maximum "k" factor: to.
 - .3 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

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

- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 VAPOUR RETARDER LAP ADHESIVE

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

2.5 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Minimum service temperatures: -20 degrees C.
 - .3 Maximum service temperature: 65 degrees C.
 - .4 Moisture vapour transmission: 0.02 perm.
 - .5 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: compatible with insulation.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

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

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at valves, flanges and unions at equipment.
- .2 Design: to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: high temperature fabric.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

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

Application	Temp Degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)		
			Run out to 1 to 2	1 1/4 to 2	2 1/2 to 4
Domestic CWS		A-3	25	25	38
Domestic CWS		A-3	25	25	25
Hot Water Heating	60 -94	A-3	25	38	38
Glycol Heating	60 -94	A-3	25	38	38
Chilled Water	4 - 13	A-3	25	25	25

.7 Finishes:

- .1 Exposed indoors: canvas jacket.
- .2 Exposed in mechanical rooms: canvas
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

3.7 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified wood.
 - .8 Low-emitting materials.

3.8 CLEANING

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

END OF SECTION

1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
 - .1 ANSI/AWS A5.8/A5.8M, Specification Filler Metals for Brazing and Bronze Welding.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B16.4, Gray-Iron Threaded Fittings.
 - .2 ANSI/ASME B16.15, Cast Bronze Threaded Fittings.
 - .3 ANSI B16.18, Cast Copper Alloy, Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.22, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B 32, Standard Specification for Solder Metal.
 - .2 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
 - .3 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .4 ASTM B 88M, Standard Specification for Seamless Copper Water Tube Metric.
 - .5 ASTM E 202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturers Standardization Society (MSS)
 - .1 MSS SP 71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .2 MSS SP 80, Bronze Gate, Globe, Angle and Check Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 28 – Health and Safety Requirements.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate on manufacturer's catalogue literature the following: VALVES.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

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

1.3 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, CEEA, TDGA, and applicable Provincial /Territorial regulations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 Products

2.1 TUBING

- .1 Type L hard drawn copper tubing: to ASTM B 88M.

2.2 FITTINGS

- .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
- .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
- .3 Cast iron threaded fittings: to ANSI/ASME B16.4.
- .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 FLANGES

- .1 Brass or bronze: threaded.
- .2 Cast iron: threaded.
- .3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

- .1 Solder, lead free, 95:5: to ASTM B 32.
- .2 Silver solder BCUP: to ANSI/AWS A5.8.
- .3 Brazing: as indicated.

2.5 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: ends for soldering.

- .2 Globe valves: application: throttling, flow control, emergency bypass:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

- .3 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified.
 - .2 NPS 2 and under:
 - .1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

- .4 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

- .5 Swing check valves:
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Flanged Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

- .6 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

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 PIPING INSTALLATION

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Assemble piping using fittings manufactured to ANSI standards.

3.3 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install ball or butterfly valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves as indicated.
- .4 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .5 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
- .6 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.
- .7 Install ball valves for glycol service.

3.4 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove hand wheel after installation and TAB is complete.

3.5 FLUSHING AND CLEANING

- .1 Flush and clean in presence of Departmental Representative
- .2 Flush after pressure test for a minimum of four (4) hours.
- .3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of eight (8) hours.
- .4 Refill system with clean water. Circulate for at least four (4) hours. Clean out strainer screens/baskets regularly. Then drain.
- .5 Refill system with clean water. Circulate for at least two (2) hours. Clean out strainer screens/baskets regularly. Then drain.

- .6 Drainage to include drain valves, dirt pockets, strainers, low points in system.
- .7 Re-install strainer screens/baskets only after obtaining Departmental Representative approval.

3.6 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment as specified glycol.

3.7 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.
 - .2 For glycol systems, retest with propylene glycol to ASTM E 202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.
- .2 Glycol Charging:
 - .1 Provide mixing tank and positive displacement pump for glycol charging.
 - .2 Retest for concentration to ASTM E 202 after cleaning.
 - .3 Provide report to Departmental Representative
 - .4 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.8 CLEANING

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

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3, Malleable Iron Threaded Fittings.
 - .3 ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .4 ASME B16.9, Factory-Made Wrought Butt welding Fittings.
 - .5 ASME B18.2.1, Square and Hex Bolts and Screws (Inch Series).
 - .6 ASME B18.2.2, Square and Hex Nuts (Inch Series).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 47/A 47M, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A 536, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E 202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CAN/CSA W48, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

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

2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 To NPS 6: Schedule 40.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape and/or lead-free pipe dope.
- .2 Flanges: plain or raised face, slip-on weld neck to AWWA C111.
- .3 Orifice flanges: slip-on raised face, 2100 kPa.
- .4 Flange gaskets: to AWWA C111.
- .5 Pipe thread: taper.
- .6 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ASME B16.1, Class 125.
 - .2 Steel: to ASME B16.5.
- .3 Unions: malleable iron, to ASTM A 47/A 47M and ASME B16.3.
- .4 Fittings for roll grooved piping: malleable iron to ASTM A 47/A 47M ductile iron to ASTM A 536.

2.4 VALVES

- .1 Connections:
 - .1 NPS2 and smaller: screwed ends.
- .2 Globe valves: to MSS-SP- 80 85 Application: Throttling, flow control, emergency bypass:
 - .1 NPS2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: Globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .3 Balancing, for TAB:
 - .1 Sizes: Calibrated balancing valves, as specified this section.
 - .2 NPS2 and under:
 - .1 Mechanical Rooms: Globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

- .2 Elsewhere: Globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
- .4 Drain valves: Ball as specified Section 23 05 23.01 - Valves - Bronze.
- .5 Swing check valves: to MSS-SP-71.
 - .1 NPS2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Silent check valves:
 - .1 NPS2 and under:
 - .1 As specified Section 23 05 23.01 - Valves - Bronze.
- .7 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

3 Execution

3.1 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 01 - Installation of Pipe Work.

3.2 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND STARTUP

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

3.4 TESTING

- .1 Test system in accordance with Section 21 05 01- Common Work Results for Mechanical.
- .2 For glycol systems, retest with ethylene propylene glycol to ASTM E 202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.5 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.

3.6 GLYCOL CHARGING

- .1 Provide mixing tank and positive displacement pump for glycol charging.
- .2 Retest for concentration to ASTM E 202 after cleaning.

3.7 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME-04(2007), Boiler and Pressure Vessel Code.
- .2 ASTM International Inc.
 - .1 ASTM A 47/A 47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 278/A 278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
 - .3 ASTM A 516/A 516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A 536-84(2004), Standard Specification for Ductile Iron Castings.
 - .5 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B51 Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

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

2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

- .1 Horizontal Vertical galvanized steel steel pressurized diaphragm type expansion tank.

- .2 Capacity: as per drawings
- .3 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.
- .4 Working pressure: 860 kPa with ASME stamp and certification 520 kPa.
- .5 Air precharged to 84 kPa (initial fill pressure of system).
- .6 Base mount for vertical installation.
- .7 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- .8 Renewable diaphragm.

2.2 AUTOMATIC AIR VENT

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 690 kPa working pressure.
- .2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.
- .3 Float: solid material suitable for 115 degrees C working temperature.

2.3 AIR SEPARATOR – IN LINE

- .1 Working pressure: 860 kPa.
- .2 Size: NPS 1 1/2 as indicated.

2.4 COMBINATION SEPARATORS / STRAINERS

- .1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.5 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B 62, solder end screwed connections, Y pattern.
- .2 Blowdown connection: NPS 1.
- .3 Screen: stainless steel brass with 1.19 mm perforations.
- .4 Working pressure: 860 kPa.

3 Execution

3.1 APPLICATION

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

3.2 GENERAL

- .1 Run drain lines and blow off connections to terminate above nearest drain.
- .2 Maintain adequate clearance to permit service and maintenance.
- .3 Should deviations beyond allowable clearances arise, request and follow DCC Representative's directive.
- .4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.3 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each automatic control valve larger than NPS 1 and radiation except at radiation and as indicated.

3.4 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

3.5 EXPANSION TANKS

- .1 Adjust expansion tank pressure to suit design criteria.
- .2 Install lockshield type valve at inlet to tank.

3.6 CLEANING

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

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for pump, circulator, and equipment, and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
 - .3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

2 Products

2.1 EQUIPMENT

- .1 Size and select components to: CSA-B214.

2.2 IN-LINE CIRCULATORS

- .1 Volute: radially split, with screwed or flanged design suction and discharge connections.
- .2 Impeller: stainless steel.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

- .4 Seal assembly: mechanical for service to 135 degrees C.
- .5 Coupling: flexible rigid self-aligning.
- .6 Capacity: as indicated
- .7 Design pressure: 860 kPa.

3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 In line circulators: install as indicated by flow arrows.
 - .1 Support at inlet and outlet flanges or unions.
 - .2 Install with bearing lubrication points accessible.
- .2 Ensure that pump body does not support piping or equipment.
 - .1 Refer to manufacturer's installation instructions for details.
- .3 Install volute venting pet cock in accessible location.
- .4 Check rotation prior to start-up.
- .5 Install pressure gauge test cocks.

3.3 START-UP

- .1 General:
 - .1 In accordance with manufacturer's recommendations.
- .2 Procedures:
 - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
 - .4 Eliminate air from scroll casing.
 - .5 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
 - .6 Adjust alignment of piping and conduit to ensure true flexibility.
 - .7 Eliminate cavitation, flashing and air entrainment.
 - .8 Adjust pump shaft seals, stuffing boxes, glands.
 - .9 Measure pressure drop across strainer when clean and with flow rates as finally set.

- .10 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .11 Verify lubricating oil levels.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code, Section VII-2004.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 28 – Health and Safety Requirements.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Closeout Submittals:
 - .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Include following:
 - .1 Log sheets as recommended by Departmental Representative

1.3 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 28 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 Products

2.1 MANUFACTURER

- .1 Equipment, chemicals, service provided by one supplier.

2.2 POT FEEDER

- .1 Welded steel, pressure rating 860 kPa. Temperature rating: 90 degrees C.

2.3 CHEMICAL FEED PIPING

- .1 Resistant to chemicals employed. Pressure rating: 860 kPa.

2.4 CHEMICAL FEED PUMPS

- .1 Piston type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with stainless steel piston, pressure relief valve, double ball and check valves.

2.5 SHIPPING/FEEDING CHEMICAL CONTAINERS

- .1 High density moulded polyethylene, with liquid level graduations, cover.

2.6 CONDUCTIVITY CONTROLLER

- .1 Fully transistorized, suitable for wall or flush panel mounting, linear over full measuring range of 0-5000 micromhs.
- .2 Insensitive to phase angle shifts, capable of operating on 95-130 Volts without affecting accuracy, power, bleedoff status lights.

2.7 CONDUCTIVITY PROBES

- .1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.

2.8 WATER TREATMENT FOR HYDRONIC SYSTEMS

- .1 Hot water heating system: pot feeder, 25 L, operating pressure 100 kPa.
- .2 Micron filter for each pot feeder:
 - .1 Capacity 2% of pump recirculating rate at operating pressure.
 - .2 Six (6) sets of filter cartridges for each type, size of micron filter.

2.9 TEST EQUIPMENT

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

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 HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.3 CHEMICAL FEED PIPING

- .1 Install crosses at changes in direction. Install plugs in unused connections.

3.4 CLEANING OF MECHANICAL SYSTEMS

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative
- .2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.
- .3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.
- .4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .5 Disposal of cleaning solutions approved by authority having jurisdiction.

3.5 FIELD QUALITY CONTROL

- .1 Start-up:
 - .1 Start up water treatment systems in accordance with manufacturer's instructions.
- .2 Commissioning:
 - .1 Commissioning Agency: to be installing water treatment sub-contractor water treatment supplier holder of service contract.
 - .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After start-up and before TAB of connected systems.

- .3 Pre-commissioning Inspections: verify:
 - .1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.
 - .2 Suitability of log book.
 - .3 Currency and accuracy of raw initial water analysis.
 - .4 Required quality of treated water.
- .4 Commissioning procedures - Closed Circuit Hydronic Systems:
 - .1 Analyze water in system.
 - .2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.
 - .3 Record types, quantities of chemicals applied.
- .5 Training:
 - .1 Provide training for facility maintenance staff in accordance with 01 79 00 – Demonstration and Training.
 - .2 Train O&M personnel in softener regeneration procedures.
- .6 Certificates:
 - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .7 Commissioning Reports:
 - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Departmental Representative
- .8 Commissioning activities during Warranty Period:
 - .1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.

3.6 CLEANING

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

END OF SECTION

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 A 480/A 480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A 653/A 653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

<u>Maximum Pressure Pa</u>	<u>SMACNA Seal Class</u>
500	C
250	C
125	C

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

2.2 SEALANT

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

2.3 TAPE

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

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
 - .1 Rectangular: short radius with single thickness turning vanes
- .3 Mitred elbows, rectangular: with double thickness turning vanes.
- .4 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30degrees maximum included angle.
- .5 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.5 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA, proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.6 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.

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

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
- .4 Upper hanger attachments:
 - .1 For steel beams: manufactured beam clamps.
 - .2 For steel joist: manufactured joist clamp steel plate washer.

3 Execution

3.1 GENERAL

- .1 Do work in accordance with SMACNA and as indicated.
- .2 Support risers in accordance with SMACNA and as indicated.

3.2 HANGERS

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

<u>Duct Size</u> (mm)	<u>Spacing</u> (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Outside air intake.
 - .2 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Line sides and bottom of ducts with weather barrier membrane
 - .2 Weld joints of bottom and side sheets.
 - .3 Seal other joints with duct sealer.
- .3 Slope horizontal ductwork down towards plenum served.
- .4 Fit base of riser with 150 mm deep drain sump and 32 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

1 General

1.1 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 28 – Health and Safety Requirements.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

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

1.4 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 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm as indicated.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon 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: [[100] mm].
- .4 Bearings: [pin in bronze bushings] [self-lubricating nylon].
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

3.3 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Tests to cover period of not less than days and demonstrate that system is functioning as specified.

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

1 General

1.1 REFERENCES

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 28 – Health and Safety Requirements.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 28 - Health and Safety Requirements.
- .2 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

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.

2 Products

2.1 MULTI-LEAF DAMEPRS

- .1 Opposed and parallel blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 2500Pa differential across damper.
- .6 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

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 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .4 Ensure dampers are observable and accessible.

3.3 CLEANING

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

END OF SECTION

1 General

1.1 REFERENCES

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A-2012, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112-10, Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2-07, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 28 – Health and Safety Requirements.
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Fire stop flaps.
 - .3 Fusible links.
 - .4 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 QUALITY ASSURANCE

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

1.4 MAINTENANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

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

2 Products

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type A, listed and bear label of ULC UL Warnock Hersey, meet requirements of provincial fire authority Fire Commissioner of Canada (FCC) CFFM and ANSI/NFPA 90A authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section as indicated.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Factory sleeve.

- .9 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .10 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.
- .11 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

3.3 CLEANING

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

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.
- .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 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 (Addendum No.1, November 1997).
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.
- .5 Underwriters' Laboratories Inc. (UL).
 - .1 UL 181-96, Standard for Factory-Made Air Ducts and Air Connectors.
- .6 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures
- .2 Product Data: submit WHMIS MSDS in accordance with Section 01 35 28 – Health and Safety Requirements:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE AND HANDLING

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

2 Products

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC – ACOUSTIC INSULATED

- .1 Type 7 : non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible mineral fibre acoustic insulation and encased in aluminum foil/mylar laminate Type M vapour barrier, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3 .
 - .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

	Frequency (Hz)				
Duct	125	250	500	1000	2000
Diam:					
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

3 Execution

3.1 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110 UL-181 SMACNA

END OF SECTION

1 General

1.1 REFERENCES

- .1 Air Conditioning and Mechanical Contractors (AMCA)
 - .1 AMCA Publication 99-2003, Standards Handbook.
 - .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

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, total static pressure, bhp W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
 - .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 28 – Health and Safety Requirements.

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

- .3 Provide:
 - .1 Fan performance curves showing point of operation, kW and efficiency.
 - .2 Sound rating data at point of operation.

- .4 Indicate:
 - .1 Motors, sheaves, bearings, shaft details .
 - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.

- .5 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.

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

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 28 - Health and Safety Requirements.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Spare parts to include:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.6 DELIVERY, STORAGE AND HANDLING

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

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

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: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment. inlet outlet dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 CENTRIFUGAL FANS

- .1 Fan wheels:
 - .1 Welded steel construction.
 - .2 Maximum operating speed of centrifugal fans not more than 50 % of first critical speed.
 - .3 Air foil or backward inclined blades, as indicated.
- .2 Bearings: split pillow-block grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours.
- .3 Housings:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, for smaller wheels, braced, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
 - .3 Provide latched airtight access doors with handles.

2.3 IN-LINE CENTRIFUGAL FANS

- .1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and direct belt drive.
- .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

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.

3.3 ANCHOR BOLTS AND TEMPLATES

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

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

1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

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 certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Test data: to ANSI/AMCA 210.
 - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
 - .2 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
- .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.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

2 Products

2.1 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

2.2 VARIABLE VOLUME BOXES

- .1 Pressure independent reset to air flow between minimum and maximum air volume.
- .2 Sizes, capacities, differential pressures and sound ratings: as indicated.
- .3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.
- .4 Complete with:
 - .1 Operator and controller: as specified under Section 25 30 02.
 - .2 Sound attenuator: as specified in Section 23 32 48 - Acoustical Air Plenums.
 - .3 Multiport outlet adapter: as indicated.
- .5 Minimum 35 kPa reset span.
- .6 Adjustable reset start point.
- .7 Adjustable reset span to maximum 70 kPa when supplied with minimum 140 kPa main control air.
- .8 No control air bleed off through inlet sensor.
- .9 Operator to be factory mounted and calibrated:
 - .1 Gauge taps for balancing with standard pressure gauge.
 - .2 Controller to have adjustable flow settings.

- .10 Casing: constructed of galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL 181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.
- .11 Damper: thick galvanized steel with peripheral gasket and self-lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

3.3 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

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

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 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.3 DELIVERY, STORAGE AND HANDLING

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

2 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.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as directed by Departmental Representative

2.2 DIFFUSERS

- .1 Square type.
- .2 Fixed pattern.
- .3 Adjustable pattern where noted.
- .4 Plaster frame where installed in drywall ceilings.

2.3 FIRE STOP FLAPS AND BLANKETS

- .1 ULC listed and labeled.
- .2 Construct of minimum 1.6 mm (16 Ga.) thick sheet steel with 1.6 mm (1/16") thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps to be held open with fusible link conforming to ULC-S505-1974 and close at 75° C or as indicated.
- .4 Thermal Blanket:
 - .1 Non-asbestos ceramic thermal blanket.
 - .2 Follow slope of diffusers.

2.4 SUPPLY GRILLES AND REGISTERS

- .1 General: with opposed blade dampers.
- .2 Steel double deflection with airfoil shape, horizontal face and vertical rear bars. Primer Finish.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 General: with opposed blade dampers.
- .2 Steel 19 mm border, single 45 degrees deflection, horizontal face bars. Finish: Primed.
- .3 Type F & G: steel aluminum, 19 mm border, 25 x 25mm egg crate type face bars. Finish: Primed.

2.6 MANUFACTURED UNITS

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

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 flat head oval head cadmium plated screws in countersunk holes where fastenings are visible.

3.3 CLEANING

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

END OF SECTION

1 General

1.1 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA).
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.1 Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.14, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .3 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .4 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Underwriters' Laboratories of Canada
 - .1 ULC -S111-95, Standard Method of Fire Tests for Air Filter Units.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

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

1.4 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.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals.

2 Products

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

2.2 FIBROUS GLASS PANEL FILTERS

- .1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.
- .2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.
- .3 Performance: 30-35%(MERV 8) to ASHRAE 52..
- .4 Fire rated: to ULC -S111.
- .5 Nominal thickness: 50 mm.

2.3 CARTRIDGE TYPE FILTERS, 80-85 % EFFICIENCY

- .1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.

- .4 Performance: 80-85% MERV 14.
- .5 Fire rated: to ULC -S111.
- .5 Nominal thickness: 100 mm.

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 GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 REPLACEMENT MEDIA

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.4 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.5 CLEANING

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

END OF SECTION

1 General

1.1 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 430, Central-Station Air-Handling Units.
- .2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation, filters, adhesives, and paints, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate following: fan, fan curves showing point of operation, motor, drive, filters, mixing box, dampers, coil; include performance data.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one spare sets of filters.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

1.5 DELIVERY, STORAGE AND HANDLING

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

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

2 Products

2.1 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: to ANSI/ARI 430 with ARI seal.
- .3 Horizontal, as indicated, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, dampers, heating coil, cooling coil humidifier section mixing box blender air mixing device

2.2 CASINGS

- .1 Galvanized or Phosphate treated steel reinforced and braced for rigidity.
 - .1 Hinged Inspection doors: provide access for maintenance of internal parts.
 - .2 Paint steel parts, where not galvanized, with corrosion resistant paint to CAN/CGSB 1.181 MPI-INT 5.3A.
 - .1 Paint: maximum VOC limit 250 g/L to Standard GS-11.
 - .3 Finish outside of units, inside, with rust resistant enamel.
 - .1 Enamel Finish: maximum VOC limit 250 g/L to Standard GS-11 to SCAQMD Rule 1113.
- .2 Line casing with solid steel liner.

2.3 ACOUSTIC LINER

- .1 Ensure that expanded polystyrene and polyurethane insulation materials were not produced with ozone depleting substances.
- .2 Insulate internal surface of panels with 50mm neoprene coated rigid duct liner of 72kg/m³ density.
 - .1 Recycled content: % (Post-Consumer + ½ Post-Industrial) in accordance with Section 01 35 21 - LEED Requirements.
 - .2 Apply with 100% coverage of adhesive with clip pins.
 - .1 Adhesives: maximum VOC limit 80 200 250 g/L to SCAQMD Rule 1168 to GSES GS-36.
 - .3 Cover with 0.8 mm thick perforated galvanized sheet metal.
 - .4 Cover leading and trailing edges with sheet metal nosing and at edges around access doors and panels complete with 15 mm overlap.

2.4 DRAIN PANS

- .1 Construction: stainless steel. Rounded corners.
- .2 Insulation: external foam type, minimum 13 mm thick.

- .3 Drain connection: in bottom at low point.
- .4 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.
- .5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or eliminator and to include return bends and headers.

2.5 FANS

- .1 Free standing AMCA-rated for sound and performance centrifugal fans with airfoil wheels, selected to operate in stable part of performance curve at times and heavy duty 200,000 hours service self aligning split pillow block bearings.
 - .1 Provide internally mounted motor as indicated complete with adjustable V-belt drive and guard.
- .2 Maximum sound power levels, as indicated.
- .3 Internally mounted motor and fan.

2.6 VIBRATION ISOLATION

- .1 Flexible connections at inlet and outlet of fan section: to Section 23 33 00 - Air Duct Accessories.
- .2 Vibration isolators on fan section as indicated in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.7 FILTER BOX

- .1 Material to match casing. For flat V bag type filter arrangement: as indicated.
 - .1 Provide access to filter through hinged door removable panels with suitable hardware.
- .2 Provide blank-off plates and gaskets to prevent air bypass.
- .3 Filters: in accordance with Section 23 44 00 - HVAC Air Filtration.
 - .1 Minimum Efficiency Reporting Value (MERV) of 8 filtration media to ASHRAE 52.2 , to be used on return air section of air handling unit.
 - .2 Immediately prior to occupancy, replace filtration media with new filtration media with Minimum Efficiency Reporting Value (MERV) of 13 in accordance with ASHRAE 52.2.

2.8 MIXING BOX

- .1 Material to match casing and produce uniformly mixed air temperature within plus or minus 5 degrees C of design across face of outlet.
- .2 Dampers:
 - .1 Dampers for mixing boxes: in accordance with Section 23 33 15 - Dampers - Operating.

2.9 BLENDER STATIC AIR MIXING DEVICE

- .1 General:
 - .1 Pre-engineered device with no moving parts, designed to thoroughly mix warm and cold air streams, to within 3 degrees C at Pa pressure drop and to provide for even velocity distribution profile.
- .2 Construction:
 - .1 2 mm thick aluminum 1.6 mm thick steel with corrosion resistant paint.
 - .2 Paint: maximum VOC limit 250 g/L to Standard GS-11 to SCAQMD Rule 1113.
- .3 Blender section:
 - .1 Blender in housing ready for insertion into air handling unit.
 - .2 1.2 mm thick steel having 50 mm flanges on inlet and outlet, finished with corrosion resistant paint zinc coating.
 - .3 Complete with 25 mm, 32kg/m³ density, fibreglass lining and insulated access door.

2.10 COILS

- .1 Capacity: as indicated.
- .2 Ratings: ARI certified.
- .3 Construction:
 - .1 Casings: 1.5 mm thick galvanized sheet steel.
 - .1 Supports of galvanized steel channel double angle frames.
 - .2 Blank-off plates. Insulated sandwich construction.
 - .2 Hot and Chilled water coils: cleanable fins.
 - .1 Tubes: copper brass steel.
 - .2 Fins: copper aluminum plate spiral wound.
 - .3 Headers: cast iron steel cast brass.
 - .4 Pressure tests: 1.7 MPa.

2.11 HUMIDIFIERS

- .1 In accordance with Section 23 84 13 – Humidifiers.

3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Provide appropriate protection apparatus.

- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.

3.3 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

3.4 DRIP PANS

- .1 Install deep seal P-traps and trap seal primer on drip lines.
 - .1 Depth of water seal to be 1.5 times static pressure at this point.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 – Cleaning.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for packaged electrode steam generating, type humidifiers and accessories.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.
- .3 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for heating, ventilation and air conditioning distribution piping and ductwork.
- .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Instructions: submit manufacturer's installation instructions.
- .7 Manufacturer's field reports specified.
- .8 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.

2 Products

2.1 PACKAGED ELECTRODE STEAM GENERATING TYPE

- .1 CSA certified and ULC listed.

- .2 Components housed in factory fabricated cabinet with factory enameled finish and electrically interlocked door.
- .3 Factory sealed disposable steam cylinder complete with factory installed electrodes to suit water condition.
- .4 Controls:
 - .1 Solid state panel.
 - .2 Solenoid valve on water and drain lines.
 - .3 Wall Duct humidistat.
 - .4 Airflow proving switch.
 - .5 Adjustable flush cycle timer.
 - .6 Amp meter.
 - .7 Cylinder replacement indicator light.
- .5 Duct distribution header complete with condensate drain and supply hose.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with manufacturers' instructions.
- .2 Humidifier and evaporator media to be new and clean when project is accepted.
- .3 Install humidistat as indicated
- .4 Water service overflow drain: to manufacturers' recommendation.
- .5 Install access doors or panels in adjacent ducting.
- .6 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.
- .7 Install capped drain connection at low point in duct.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

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

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

- .3 Performance Verification (PV):
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
 - .2 Application tolerances: .
 - .3 Timing:
 - .1 After TAB of ducted air systems.
 - .2 At same time as PV of related air handling units.

- .4 Start-up:
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
 - .2 Verify:
 - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
 - .2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
 - .3 Visually check distribution manifold to ensure:
 - .1 Even distribution of vapour.
 - .2 Freedom from water deposits.

- .5 Commissioning Reports:
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified. Include:
 - .1 PV results on approved PV Report Forms.
 - .2 Product Information Report Forms.

END OF SECTION