

**Part 1            General**

**1.1                SUBMITTALS**

- .1        Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .3        Shop drawings to show:
  - .1        Mounting arrangements.
  - .2        Operating and maintenance clearances.
- .4        Shop drawings and product data accompanied by:
  - .1        Detailed drawings of bases, supports, and anchor bolts.
  - .2        Acoustical sound power data, where applicable.
  - .3        Points of operation on performance curves.
  - .4        Manufacturer to certify current model production.
  - .5        Certification of compliance to applicable codes.
- .5        In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6        Closeout Submittals:
  - .1        Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2        Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator 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 two (2) copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless directed by Contract Administrator.
  - .2 Make changes as required and re-submit as directed by Contract Administrator.
- .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 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 Contract Administrator 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 .

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**1.3 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One glass for each gauge glass.
  - .4 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals .
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

**Part 2 Execution**

**2.1 PAINTING REPAIRS AND RESTORATION**

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

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**2.2 CLEANING**

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

**2.3 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.

**2.4 DEMONSTRATION**

- .1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 HVAC System.
- .3 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.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Contract Administrator will record these demonstrations on video tape for future reference.

**2.5 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1                SUMMARY**

- .1        Section Includes:
  - .1            Use of mechanical systems during construction.

**1.2                USE OF SYSTEMS**

- .1        Use of new and/or existing permanent heating ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:
  - .1            Entire system is complete.
  - .2            Building has been closed in; areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .3            There is no possibility of damage.
  - .4            Supply ventilation systems are protected by 60% filters, inspected daily, and changed every week or more frequently as required.
  - .5            Return systems have approved filters over openings, inlets and outlets.
  - .6            Systems will be:
    - .1            Operated as per manufacturer's recommendations and instructions.
    - .2            Operated by Contractor.
    - .3            Monitored continuously by Contractor.
  - .7            Warranties and guarantees are not relaxed.
  - .8            Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Contract Administrator.
  - .9            Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.
- .2        Filters specified in this Section are over and above those specified in other Sections of this project.
- .3        Exhaust systems are not included in approvals for temporary heating ventilation.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1    Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2    Green Seal Environmental Standards (GSES)
  - .1        Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .3    National Fire Code of Canada (NFCC 2005)

**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 piping and equipment 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.
- .3    Waste Management and Disposal:
  - .1        Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2        Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3        Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1    Low-Emitting Materials: Adhesives and Sealants.
    - .1            Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4        Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1            Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.

- .2      VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
- .3      Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

**Part 2            Products**

**Part 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                CONNECTIONS TO EQUIPMENT**

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

**3.3                CLEARANCES**

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

**3.4                DRAINS**

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

**3.5                AIR VENTS**

- .1      Install manual air vents to high points in piping systems.

- .2      Install isolating valve at each automatic air valve.
- .3      Install drain piping to approved location and terminate where discharge is visible.

### **3.6            DIELECTRIC COUPLINGS**

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

### **3.7            PIPEWORK INSTALLATION**

- .1      Screwed fittings jointed with Teflon tape.
- .2      Protect openings against entry of foreign material.
- .3      Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4      Assemble piping using fittings manufactured to ANSI standards.
- .5      Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
  - .1      Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6      Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7      Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8      Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9      Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10     Group piping wherever possible and as indicated.
- .11     Ream pipes, remove scale and other foreign material before assembly.
- .12     Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13     Provide for thermal expansion as indicated.



- .14    Valves:
  - .1    Install in accessible locations.
  - .2    Remove interior parts before soldering.
  - .3    Install with stems above horizontal position unless indicated.
  - .4    Valves accessible for maintenance without removing adjacent piping.
  - .5    Install globe valves in bypass around control valves.
  - .6    Use gate /ball valves at branch take-offs for isolating purposes except where specified.
  - .7    Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .8    Install plug ball valves for glycol service.
  - .9    Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

- .15    Check Valves:
  - .1    Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
  - .2    Install swing check valves in horizontal lines on discharge of pumps and as indicated.

### **3.8            SLEEVES**

- .1    General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2    Material: schedule 40 black steel pipe.
- .3    Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4    Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5    Installation:
  - .1    Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2    Other floors: terminate 25 mm above finished floor.
  - .3    Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6    Sealing:
  - .1    Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2    Elsewhere:
    - .1    Provide space for firestopping.

- .2      Maintain fire rating integrity.
- .3      Sleeves installed for future use: fill with lime plaster or other easily removable filler.
- .4      Ensure no contact between copper pipe or tube and sleeve.

### **3.9            ESCUTCHEONS**

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

### **3.10          PREPARATION FOR FIRE STOPPING**

- .1      Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2      Uninsulated unheated pipes not subject to movement: no special preparation.
- .3      Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4      Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

### **3.11          FLUSHING OUT OF PIPING SYSTEMS**

- .1      Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2      Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning.
- .3      Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

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

- .1      Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.
- .2      PIPework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3      Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4      Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

- .5      Conduct tests in presence of Contract Administrator.
- .6      Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.
- .7      Insulate or conceal work only after approval and certification of tests by Contract Administrator.

**3.13            EXISTING SYSTEMS**

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

**3.14            CLEANING**

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

**END OF SECTION**

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**Part 1            General**

**1.1                SUMMARY**

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

**1.2                REFERENCES**

- .1    American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1    ASHRAE 90.1-01, 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                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.
  - .2    Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .3    Closeout Submittals
  - .1    Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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**1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, TDA, and applicable Provincial regulations.

**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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

**Part 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, 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.

## **2.3 TEMPORARY MOTORS**

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

## **2.4 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.

## **2.5 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.

### **Part 3 Execution**

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

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

#### **3.2 INSTALLATION**

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

#### **3.3 FIELD QUALITY CONTROL**

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

#### **3.4 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1-2007, Power Piping.
  - .2 ANSI/ASME B31.3-2006, Process Piping.
  - .3 ANSI/ASME Boiler and Pressure Vessel Code-2007:
    - .1 BPVC 2007 Section I: Power Boilers.
    - .2 BPVC 2007 Section V: Nondestructive Examination.
    - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
  - .1 AWS C1.1M/C1.1-2000(R2006), Recommended Practices for Resistance Welding.
  - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
  - .3 AWS W1-2000, Welding Inspection Handbook..
- .4 Canadian Standards Association (CSA International)
  - .1 CSA W47.2-M1987(R2008), Certification of Companies for Fusion Welding of Aluminum.
  - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .3 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.
  - .4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.
  - .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
  - .6 CSA W178.2-2008, Certification of Welding Inspectors.

**1.2                QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Welders:
    - .1 Welding qualifications in accordance with CSA B51.
    - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
    - .3 Submit welder's qualifications to Contract Administrator.
    - .4 Each welder to possess identification symbol issued by authority having jurisdiction.



- .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors:
  - .1 Inspectors qualified to CSA W178.2.
- .3 Certifications:
  - .1 Registration of welding procedures in accordance with CSA B51.
  - .2 Copy of welding procedures available for inspection.
  - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

### 1.3 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 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## Part 2 Products

### 2.1 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

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**Part 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 QUALITY OF WORK**

- .1 Welding: in accordance with ANSI/ASME B31.1 B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in Division 15 applicable requirements of provincial authority having jurisdiction.

**3.3 INSTALLATION REQUIREMENTS**

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
  - .1 Where used, fit to minimize gaps between ring and pipe bore.
  - .2 Do not install at orifice flanges.
- .3 Fittings:
  - .1 NPS 2 and smaller: install welding type sockets.
  - .2 Branch connections: install welding tees or forged branch outlet fittings.

**3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS**

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Contract Administrator before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Contract Administrator.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

**3.5 SPECIALIST EXAMINATIONS AND TESTS**

- .1 General:
  - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Contract Administrator.
  - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
  - .3 Inspect and test 25% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.

- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of visual examinations:
  - .1 Upon failure of welds by visual examination, perform additional testing as directed by Contract Administrator of total of up to 10 % of welds, selected at random by Contract Administrator by radiographic particle tests.

**3.6 DEFECTS CAUSING REJECTION**

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

**3.7 REPAIR OF WELDS WHICH FAILED TESTS**

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

**3.8 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 SECTION INCLUDES**

- .1 Materials and installation for thermometers and pressure gauges in piping systems.

### **1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 23 05 53.01 - Mechanical Identification.

### **1.3 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.
  - .2 ASME B40.200-01, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
  - .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

### **1.4 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.
  - .4 Syphons.
  - .5 Wells.

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.

- .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
  - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
- .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
  - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
  - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
  - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Design point to be at mid point of scale or range.
- .2 Ranges:
  - .1 Heating water: 50-250°F
  - .2 Domestic water: 32-200 °F.
  - .3 Domestic water: 0-100 psig.
  - .4 Heating systems: 0-100 psig.

### **2.2 DIRECT READING THERMOMETERS**

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB14.4 ASME B40.200.

### **2.3 REMOTE READING THERMOMETERS**

- .1 100 mm diameter mercury-free activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.

### **2.4 THERMOMETER WELLS**

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

### **2.5 PRESSURE GAUGES**

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.

- .2 Provide:
  - .1 Snubber for pulsating operation.
  - .2 Diaphragm assembly for corrosive service.
  - .3 Gasketed pressure relief back with solid front.
  - .4 Bronze stop cock.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.
- .3 Gauges and thermostats shall indicate both metric and imperial.

#### **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 Heat exchangers.
  - .2 Water heating and cooling coils.
  - .3 Water boilers.
  - .4 DHW tanks.
- .3 Install wells 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 PRV's.
  - .3 Upstream and downstream of control valves.
  - .4 Inlet and outlet of coils.
  - .5 Inlet and outlet of liquid side of heat exchangers.
  - .6 Outlet of boilers.
  - .7 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 lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

**END OF SECTION**

**Part 1            General**

**1.1                SUMMARY**

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

**1.2                REFERENCES**

- .1    American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
  - .1        ANSI/ASME B1.20.1-1983(R2001), Pipe Threads, General Purpose (Inch).
  - .2        ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2    American Society for Testing and Materials International, (ASTM).
  - .1        ASTM A276-04, Specification for Stainless Steel Bars and Shapes.
  - .2        ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
  - .3        ASTM B283-99a, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  - .4        ASTM B505/B505M-02, Specification for Copper-Base Alloy Continuous Castings.
- .3    Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  - .1        MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2        MSS-SP-80-2003, Bronze Gate Globe, Angle and Check Valves.
  - .3        MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

**1.3                SUBMITTALS**

- .1    Submittals in accordance with Section 01 33 00 - Submittal Procedures .
- .2    Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
  - .1        Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
  - .2        Submit data for valves specified in this section.
- .3    Closeout Submittals:
  - .1        Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.



## 1.4 DELIVERY STORAGE AND DISPOSAL

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## 1.5 MAINTENANCE

- .1 Extra Materials:
- .2 Furnish following spare parts:
  - .1 Valve seats: one for every 10 valves each size, minimum 1.
  - .2 Discs: one for every 10 valves, each size. Minimum 1.
  - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
  - .4 Valve handles: 2 of each size.
  - .5 Gaskets for flanges: one for every 10 flanged joints.

## Part 2 Products

### 2.1 MATERIALS

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

- .2 Copper tube systems: Solder ends to ANSI/ASME B16.18.
- .3 Lockshield Keys:
  - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
- .4 Gate Valves:
  - .1 Requirements common to gate valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Bonnet: union with hexagonal shoulders.
    - .3 Connections: screwed with hexagonal shoulders.
    - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
    - .5 Packing: non-asbestos.
    - .6 Handwheel: non-ferrous.
    - .7 Handwheel Nut: bronze to ASTM B62.
  - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
    - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
    - .2 Operator: Handwheel .
  - .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
    - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
    - .2 Operator: Handwheel .
- .5 Globe Valves:
  - .1 Requirements common to globe valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Bonnet: union with hexagonal shoulders.
    - .3 Connections: screwed with hexagonal shoulders.
    - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
    - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
    - .6 Handwheel: non-ferrous.
    - .7 Handwheel Nut: bronze to ASTM B62.
  - .2 NPS 2 and under, composition disc, Class 125:
    - .1 Body and bonnet: screwed bonnet.
    - .2 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
    - .3 Operator: Lockshield.
  - .3 NPS 2 and under, composition disc, Class 150:
    - .1 Body and bonnet: union bonnet.
    - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

- 
- .3 Operator: Lockshield.
  - .6 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 rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.
    - .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.
  - .7 Ball Valves:
    - .1 NPS 2 and under:
      - .1 Body and cap: cast high tensile bronze to ASTM B62.
      - .2 Pressure rating: Class125 CWP, 860 kPa steam.
      - .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 solid ball and teflon seats.
      - .7 Stem seal: TFE with external packing nut.
      - .8 Operator: removable lever handle.

**Part 3            Execution**

**3.1                INSTALLATION**

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

**END OF SECTION**

**Part 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 A49-01(2006), Standard Specification for Heat-Treated Carbon Steel Joint Bars.
  - .2 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .3 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
  - .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
  - .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6 ASTM B85/B85M-08, Standard Specification for Aluminum-Alloy Die Castings.
  - .7 ASTM B209-07, 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-61-03, Pressure Testing of Steel Valves.
  - .2 MSS SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS SP-82-1992, Valve Pressure Testing Methods.
  - .5 MSS SP-85-2002, 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.
- .3 Shop Drawings:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.

**1.3                CLOSEOUT SUBMITTALS**

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

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#### 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.
- .3 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ - 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ - 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
  - .1 Valve seats: one for every 10 valves each size, minimum 1.
  - .2 Discs: one for every 10 valves, each size, minimum 1.
  - .3 Stem packing: one for every 10 valves, each size, minimum 1.
  - .4 Valve handles: 2 of each size.
  - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.
  - .2 Include following:
    - .1 Lubricant gun for expansion joints.

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**Part 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 B209 Class B.
  - .2 Connections: flanged ends plain face with 2 mm raised face with serrated finish 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 B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
  - .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, 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 B62.
  - .3 Seat rings: renewable bronze to ASTM B62, screwed into body.
  - .4 Stem: bronze to ASTM B62.
  - .5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
  - .6 Seat: integral with body.
  - .7 Stem: wrought steel.
  - .8 Operator: handwheel.
  - .9 Bypass: complete with union and gate valve.

- .2 NPS 2 1/2-8, outside screw and yoke (OS&Y), 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 B62 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.
  - .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 globe valve.

### 2.3 GLOBE VALVES

- .1 NPS 2 1/2 - 10, OSY:
  - .1 Body: with multiple-bolted bonnet.
  - .2 WP: 860 kPa steam, 1.4 MPa CWP.
  - .3 Bonnet-yoke gasket: non-asbestos.
  - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
  - .5 Seat ring: renewable, regrindable, and screwed into body.
  - .6 Stem: bronze to ASTM B62.
  - .7 Operator: handwheel.

### 2.4 BYPASSES FOR GATE AND GLOBE VALVES

- .1 Locations: on valves as indicated.
- .2 Size of bypass valve:
  - .1 Full size of pipe and valve being bypassed unless noted otherwise.
- .3 Type of bypass valves:
  - .1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze . Pressure rating to match main valve.
  - .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze . Pressure rating to match main valve.



## 2.5 VALVE OPERATORS

- .1 Install valve operators as follows:
  - .1 Handwheel: on valves except as specified.
  - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms and mechanical equipment rooms.

## 2.6 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 A126 Class B.
    - .2 NPS 18 and over: cast iron to ASTM A126 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 B62.
    - .2 NPS 8 and over: bronze-faced cast iron.
  - .4 Seat rings: renewable bronze to ASTM B62 screwed into body.
  - .5 Hinge pin, bushings: renewable bronze to ASTM B62.
  - .6 Disc: A126 Class B, secured to stem, rotating for extended life.
  - .7 Seat: cast iron, integral with body.
  - .8 Hinge pin: exelloy; bushings: malleable iron.
  - .9 Identification tag: fastened to cover.
  - .10 Hinge: galvanized malleable iron.
- .2 Swing check valves, NPS 2 1/2 - 8 Class 250:
  - .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
  - .2 Flanged ends: 2 mm raised face with serrated finish.
  - .3 Rating: 250 psi steam; 500 psi CWP.
  - .4 Disc: rotating for extended life.
    - .1 Up to NPS 3: bronze to ASTM B61.
    - .2 NPS 4 - 8: iron faced with ASTM B61 bronze.
  - .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
  - .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
  - .7 Hinge: galvanized malleable iron.
  - .8 Identification tag: fastened to cover.

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**2.7 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 renewable rotating disc.
  - .5 Seat: renewable, EPDM.
  - .6 Stainless steel spring, heavy duty.

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

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

.1 Section Includes:

.1 Plug Valves - Lubricated plug valves, Eccentric plug valves.

### **1.2 REFERENCES**

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).

.1 ANSI/ASME B1.20.1-1983(R2001), Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.

.3 ANSI/ASME B16.11-2001, Forged Fittings, Socket-Welding and Threaded.

.4 ANSI/ASME B16.25-1997, Buttwelding Ends.

.5 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding End.

.6 ANSI/ASME B16.10-2000, Face to Face and End to End Dimensions of Valves.

.2 American Society for Testing and Materials International (ASTM).

.1 ASTM A126-95(2000), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B209-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry Inc. (MSS).

.1 MSS SP-78-1998, Cast Iron Plug Valves, Flanged and Threaded Ends.

### **1.3 SUBMITTALS**

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

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

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

.3 Submit data for valves specified this Section.

.3 Closeout Submittals:

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

## 1.4 DELIVERY STORAGE AND DISPOSAL

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.
  - .2 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

## 1.5 MAINTENANCE

- .1 Extra Materials:
- .2 Furnish following spare parts:
  - .1 Valve seats: one for every 10 valves each size, minimum 1.
  - .2 Discs: one for every 10 valves, each size, minimum 1.
  - .3 Stem packing: one for every 10 valves, each size, minimum 1.
  - .4 Valve handles: 2 of each size.
  - .5 Gaskets for flanges: one for every 10 flanged joints.

## Part 2 Products

### 2.1 MATERIAL

- .1 Valves:

- .1 Except for specialty valves, to be of single manufacturer.
- .2 Products to have CRN registration number.

## 2.2 ECCENTRIC PLUG VALVES - SCREWED ENDS

- .1 General:
  - .1 Dead-tight shut-off on liquids and gases at pressure differentials up to 1.2 MPa in forward direction, 520 kPa in reverse direction.
  - .2 Up to NPS 2, screwed ends:
    - .1 Body: cast iron to ASTM B209 Class B.
    - .2 Plug:
      - .1 NPS 1/2 and 3/4: bronze to ASTM B62.
      - .2 NPS 1 to NPS 2: bronze to ASTM B62.
    - .3 Bearings: permanently lubricated, bronze to ASTM B62 in upper and lower journals.
    - .4 Seals: double-seal consisting of:
      - .1 Plastic seat coating between plug and body.
      - .2 Resilient seal moulded into groove in plug face.
      - .3 Seal materials: BUNA Stem seals with Neoprene ,Petroleum HYCAR plug seals.
      - .4 VITON stem seals with Fluorinated hydrocarbon plug seals.
      - .5 Isobutene Isoprene stem seal with isobutene-isoprene plug seals.
    - .5 End connections: screwed.
    - .6 Operators: lever.
  - .3 NPS 2 1/2 to NPS 4, flanged ends:
    - .1 Body: cast iron to ASTM B209 Class B.
    - .2 Plug: nickel-plated cast iron to ANSI.
    - .3 Bearings: permanently lubricated, bronze to ASTM B62 in upper and lower journals.
    - .4 Seals: double-seal consisting of:
      - .1 Plastic seat coating between plug and body.
      - .2 Resilient seal moulded into groove in plug face.
      - .3 Seal materials: BUNA Stem seals with Neoprene Petroleum HYCAR plug seals.
      - .4 VITON stem seals with Fluorinated hydrocarbon plug seals.
      - .5 Isobutene Isoprene stem seal with isobutene-isoprene plug seals.
    - .5 End connections: flanged to ANSI B16.1.
    - .6 Operators: lever.

## 2.3 LUBRICATED PLUG VALVES

- .1 Principle of operation:

- .1 Special sealing compound used to effect tight seal. When line pressure applied to valve in closed position, parallel plug forced against downstream side of valve. The metal-to-metal contact and sealing compound ensures leak-tight seal.
- .2 Testing to specifications: MSS SP-78 for non-shock pressure at specified temperature.
- .3 End connections:
  - .1 NPS 1/2 to 2: screwed ends.
  - .2 NPS 22 to 12: flanged ends.
- .4 Valve:
  - .1 Body: cast iron to ASTM A126 Class B semi-steel.
  - .2 Pressure rating: NPS 1/2 to 12:
    - .1 Screwed end valves: screwed to NPT standards.
    - .2 Flanged end valves: flanged to ANSI B16.1 Class 125. Flanged valves NPS 2-8 face dimensions in accordance with ANSI B16.10 short pattern, making them interchangeable with Class 125 flanged cast iron gate valves.
    - .3 Hydrostatic tests: body 300 psig. Seat: 100 psig.
  - .3 Plug: cylindrical or tapered, with regular venturi round pattern port - 90 degrees from full open to fully closed, complete with PTFE thrust ring: 100% full port.
  - .4 Number of ports: as indicated.
  - .5 Ends: with hexagon shoulders, ends screwed to ANSI B1.20.1 or Flanged to ANSI B16.1 or butt welding to ANSI B16.25 socket-welding to ANSI B16.11.
  - .6 Lubrication system, nickel-plated.
  - .7 Lubricant: to suit type, temperature and pressure of contained fluid.
  - .8 Provide sealing compound injection gun designed for use with pre-packed sealing compound cartridges and valve fitted with button head nipples and combination sealing screws.
  - .9 Feeding system: lubricant forced into lubrication grooves between seating surfaces of plug and body to form positive seal, leakproof operation, and corrosion preventing film. Lubricant receptacle to hold additional lubricant. Lubricant screw for lubrication. Check valve to prevent reverse flow of lubricant. O-rings between body and plug.
- .5 Operator:
  - .1 Up to NPS 5: manual lever.
  - .2 NPS 6 - 8: CGA approved gear-operated handwheel.
  - .3 NPS 6 - 12: gear-operated handwheel with screwed bottom cover.

- .6 3-port and 4 port valves:
  - .1 To be supplied transflow pattern, to allow reduced flow through ports during rotation of plug from one position to another.
  - .2 Limit stops: to be provided.
- .7 Accessories: lubricant gun.

**Part 3 Execution**

**3.1 INSTALLATION OF LUBRICATED PLUG VALVES**

- .1 Install with line pressure acting to hold plug against body ports which are to be cut-off from higher pressure.

**3.2 COMMISSIONING OF LUBRICATED PLUG VALVES**

- .1 Determine the type of sealing compound for particular application.
- .2 Open and close valve at least 3 times to ensure distribution of sealing compound evenly and to ensure tight shut-off.
- .3 When operating valve, ease valve off body to ensure that plug is free to float.
- .4 Determine frequency of re-lubrication during commissioning of remainder of system.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
  - .2 ASME B16.1-05, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
  - .3 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
  - .4 ANSI/ASME B16.11-05, Forged Fittings, Socket-Welding and Threaded.
  - .5 ANSI/ASME B16.25-07, Buttwelding Ends.
  - .6 ANSI/ASME B16.34-04, Valves - Flanged, Threaded and Welding Ends.
- .2 American Petroleum Institute (API)
  - .1 API Std. 609-04, Butterfly Valves: Double Flanged, Lug- and Wafer-Type.
- .3 ASTM International Inc.
  - .1 ASTM A126-04), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
  - .3 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .4 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate Metric.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS SP-67-02a, Butterfly Valves.

**1.2 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.
- .3 Shop Drawings:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.



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**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit 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.
- .3 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
  - .1 Valve seats: one for every 10 valves each size, minimum 1.
  - .2 Discs: one for every 10 valves, each size, minimum 1.
  - .3 Stem packing: one for every 10 valves, each size, minimum 1.
  - .4 Valve handles: 2 of each size.
  - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.

- .2 Include following:
  - .1 Lubricant gun for expansion joints.

**Part 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 Wafer Lug type: NPS 2 to 30.
- .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 135 degrees C.
- .7 Application: on-off operation.
- .8 Full lug body (threaded).
- .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: stainless.
  - .7 O-Ring: Buna-N.
  - .8 Bushings: luberized bronze.

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**Part 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 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**

**Part 1            General**

**1.1            SUMMARY**

- .1 Section Includes:
  - .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

**1.2            REFERENCES**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1-04, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A125-1996(R2001), Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563-04a, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC)

**1.3            SYSTEM DESCRIPTION**

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

- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

#### **1.4 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .3 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Contract Administrator will make available one (1) copy of systems supplier's installation instructions.
- .5 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.5 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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ - 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ - 4.2: Low-Emitting Materials: Paints and Coatings.

- .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
- .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
- .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

### **2.2 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized or painted with zinc-rich paint after manufacture.
  - .2 Use hot dipped galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
  - .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-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .5 Shop and field-fabricated assemblies:
  - .1 Trapeze hanger assemblies:
  - .2 Steel brackets.
- .6 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .7 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.3 RISER CLAMPS**

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

## **2.4            INSULATION PROTECTION SHIELDS**

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

## **2.5            CONSTANT SUPPORT SPRING HANGERS**

- .1    Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2    Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3    Provide upper and lower factory set travel stops.
- .4    Provide load adjustment scale for field adjustments.
- .5    Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6    Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## **2.6            VARIABLE SUPPORT SPRING HANGERS**

- .1    Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2    Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3    Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4    Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.7            EQUIPMENT SUPPORTS**

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



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**2.8                    EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

**2.9                    PLATFORMS AND CATWALKS**

- .1            To Section 05 50 00 - Metal Fabrications.

**2.10                  HOUSE-KEEPING PADS**

- .1            Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 150 mm larger than equipment; chamfer pad edges.
- .2            Concrete: to Section 03 30 00 - Cast-in-place Concrete.

**2.11                  OTHER EQUIPMENT SUPPORTS**

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

**Part 3                Execution**

**3.1                    MANUFACTURER'S INSTRUCTIONS**

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

**3.2                    INSTALLATION**

- .1            Install in accordance with:
  - .1            Manufacturer's instructions and recommendations.
- .2            Vibration Control Devices:
  - .1            Install on piping systems at pumps, boilers as indicated.
- .3            Clamps on riser piping:
  - .1            Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2            Bolt-tightening torques to industry standards.
  - .3            Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4            Cast iron pipes: install below joint.
- .4            Clevis plates:
  - .1            Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5            Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

### **3.3 HANGER SPACING**

- .1 Plumbing piping: to Canadian Plumbing Code and authority having jurisdiction.
- .2 Gas piping: up to NPS 1/2: every 1.8 m.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .5 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

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

### **3.4 HANGER INSTALLATION**

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

### **3.5 HORIZONTAL MOVEMENT**

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

### **3.6 FINAL ADJUSTMENT**

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

- .2     Adjustable clevis:
  - .1         Tighten hanger load nut securely to ensure proper hanger performance.
  - .2         Tighten upper nut after adjustment.
- .3     C-clamps:
  - .1         Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4     Beam clamps:
  - .1         Hammer jaw firmly against underside of beam.

**3.7            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.

**END OF SECTION**

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**Part 1 General**

**1.1 SUMMARY**

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

**1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
- .3 National Building Code of Canada (NBC) - 1995

**1.3 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .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 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
  - .2 Provide separate shop drawings for each isolated system shop drawings complete with performance and product data.
- .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.
  - .3 Manufacturer's Field Reports: manufacturer's field reports specified.

**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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 GENERAL**

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

### **2.2 ELASTOMERIC PADS**

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

### 2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

### 2.4 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for 100% relative humidity installations.
- .4 Colour code springs.

### 2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

### 2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

## **2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES**

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

## **2.8 HORIZONTAL THRUST RESTRAINT**

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

## **2.9 STRUCTURAL BASES**

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm minimum.

## **2.10 INERTIA BASE**

- .1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.
- .2 Pump bases: "T" shaped, where applicable, to provide support for elbows.
- .3 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

## **Part 3 Execution**

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

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

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### **3.2 INSTALLATION**

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

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

### **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**



**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

**1.2 REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

**1.3 SUBMITTALS**

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

**1.4 QUALITY ASSURANCE**

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

**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle 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 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

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

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

### **2.2 SYSTEM NAMEPLATES**

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

.3 Sizes:

.1 Conform to following table:

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

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

.4 Locations:

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

.2 Equipment in Mechanical Rooms: use size # 9.

## 2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

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

.3 Before starting work, obtain written approval of identification system from Contract Administrator.

## 2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.

## 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 Contract Administrator.
  - .2 Colours for legends, arrows: to following table:

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

.3 Background colour marking and legends for piping systems:		Legend
Contents	Background colour marking	
** Add design temperature		
++ Add design temperature and pressure		
Raw water	Green	RAW WATER
City water	Green	CITY WATER
Treated water	Green	TREATED WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg. supply	Yellow	HTHW HTG. SUPPLY++
High temp HW Htg. return	Yellow	HTHW HTG. RETURN++
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Drinking water return	Green	CH. DRINK WTR. CIRC
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC

Contents	Background colour marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
Domestic cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Acid waste	Yellow	ACID WASTE (add source)
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Fire protection water	Red	FIRE PROT. WTR

## **2.6 IDENTIFICATION DUCTWORK SYSTEMS**

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

## **2.7 VALVES, CONTROLLERS**

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

## **2.8 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.

## **2.9 LANGUAGE**

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

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**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 TIMING**

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

**3.3 INSTALLATION**

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

**3.4 NAMEPLATES**

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

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

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

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

### **3.6 VALVES, CONTROLLERS**

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

### **3.7 CLEANING**

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

**END OF SECTION**

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**Part 1            General**

**1.1                SUMMARY**

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

**1.2                QUALIFICATIONS OF TAB PERSONNEL**

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



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**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 Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Contract Administrator 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 Contract Administrator for verification of TAB reports.

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**1.9 START OF TAB**

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

**1.10 APPLICATION TOLERANCES**

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

**1.13 SUBMITTALS**

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

**1.14 PRELIMINARY TAB REPORT**

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

**1.15 TAB REPORT**

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

**1.16 VERIFICATION**

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

### **1.17 SETTINGS**

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

### **1.18 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by Contract Administrator.

### **1.19 AIR SYSTEMS**

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

### **1.20 OTHER TAB REQUIREMENTS**

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

- .1 Standard: Treasury Board of Canada Handbook of Occupational Health and safety, 4th edition Canada Labour Code state applicable Provincial or other standard .
- .2 TAB procedures: as described in standard.
- .3 Building pressure conditions:
  - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during winter summer design conditions at all times.
- .4 Zone pressure differences:
  - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combinations of normal operating modes.
- .5 Smoke management systems:
  - .1 Test for proper operation of all smoke and fire dampers, sensors, detectors, installed as component parts of air systems specified Division 23.
- .6 Measurement of noise and vibration from equipment specified in Division 23.

**1.21 POST-OCCUPANCY TAB**

- .1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of following areas:
  - .1 Main Floor.
  - .2 Basement.
- .2 Participate in systems checks twice during Warranty Period - #1 approximately three (3) months after acceptance and #2 within one (1) month of termination of Warranty Period.

**END OF SECTION**

**Part 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    CRD: Code Round Ductwork,
    - .2    CRF: Code Rectangular Finish.
- .2    Reference Standards:
  - .1    American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1    ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2    ASTM International Inc.
    - .1    ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
    - .2    ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .3    ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4    ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5    ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
    - .6    ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7    ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8    ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .9    ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3    Canadian General Standards Board (CGSB)
    - .1    CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

- .4 Canada Green Building Council (CaGBC)
  - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
  - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-Addendum 2007.
  - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .5 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-36-00, Commercial Adhesives.
- .6 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .7 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .8 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

## 1.2 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.
- .3 Shop Drawings:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .4 Samples:
  - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
  - .2 Mount sample on 12 mm plywood board.
  - .3 Affix typewritten label beneath sample indicating service.

- .5 Manufacturers' Instructions:
  - .1 Provide manufacture's written duct insulation jointing recommendations, and special handling criteria, installation sequence and cleaning procedures.

### 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 and ULC markings.
- .3 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## Part 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 C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with/without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with/without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C553.

## 2.3 JACKETS

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
  - .1 Maximum VOC limit 50 g/L.

## 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
    - .1 Maximum VOC limit 50 g/L.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave.
- .5 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
  - .1 Maximum VOC limit 50 g/L.
- .8 Canvas adhesive: washable.

- .1 Maximum VOC limit 50 g/L.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation and one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

### **Part 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 manufacturers instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 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.
- .6 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)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served			none
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	none		

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

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

.1 Finishes: conform to following table:

	TIAC Code	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

### 3.5 CLEANING

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

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

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    American Society for Testing and Materials International (ASTM)
  - .1        ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

**1.2            CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

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

**1.3            HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)**

- .1    Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2    When systems are operational, perform following tests:
  - .1        Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2        Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1            Pump operation.
    - .2            Boiler operation.
    - .3            Pressure bypass open/closed.
    - .4            Control pressure failure.
    - .5            Maximum heating demand.
    - .6            Maximum cooling demand.
    - .7            Boiler failure.
    - .8            Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

**1.4            HYDRONIC SYSTEM CAPACITY TEST**

- .1    Perform hydronic system capacity tests after:
  - .1        TAB has been completed
  - .2        Verification of operating, limit, safety controls.
  - .3        Verification of primary and secondary pump flow rates.
  - .4        Verification of accuracy of temperature and pressure sensors and gauges.
- .2    Calculate system capacity at test conditions.

- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
    - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 With supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
    - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

## **1.5 GLYCOL SYSTEMS**

- .1 Test to prove concentration will prevent freezing to minus 40 degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

## **1.6 GASEOUS FUEL SYSTEMS**

- .1 Operation tests:
  - .1 Measure gas pressure at gas meter outlet and at burner manifold.
  - .2 Verify details of temperature and pressure compensation at meter.
  - .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
  - .4 Check terminals of vents for gas pressure regulators.

## **1.7 POTABLE WATER SYSTEMS**

- .1 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
  - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
  - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

**1.8                      SANITARY AND STORM DRAINAGE SYSTEMS**

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

**1.9                      REPORTS**

- .1      In accordance with Section 01 91 00 – LEED Commissioning.

**1.10                    TRAINING**

- .1      In accordance with Section 01 91 00 – LEED Commissioning.

**END OF SECTION**

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**Part 1            General**

**1.1            SUMMARY**

- .1 Section Includes:
  - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

**1.2            REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3            SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Instructions: submit manufacturer's installation instructions.

**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 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.

- .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
- .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
- .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2            Products**

### **2.1            CLEANING SOLUTIONS**

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

## **Part 3            Execution**

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

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

### **3.2            CLEANING HYDRONIC SYSTEM**

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
  - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist .
- .4 Cleaning procedures:
  - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
    - .1 Cleaning procedures, flow rates, elapsed time.
    - .2 Chemicals and concentrations used.
    - .3 Inhibitors and concentrations.
    - .4 Specific requirements for completion of work.
    - .5 Special precautions for protecting piping system materials and components.
    - .6 Complete analysis of water used to ensure water will not damage systems or equipment.



- .5 Conditions at time of cleaning of systems:
  - .1 Systems: free from construction debris, dirt and other foreign material.
  - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
  - .3 Strainers: clean prior to initial fill.
  - .4 Install temporary filters on pumps not equipped with permanent filters.
  - .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning:
  - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
  - .1 Fill system with water; ensure air is vented from system.
  - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
  - .3 Use water metre to record volume of water in system to +/- 0.5%.
  - .4 Add chemicals under direct supervision of chemical treatment supplier.
  - .5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
  - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
  - .7 Add chemical solution to system.
  - .8 Establish circulation, raise temperature slowly to maximum design 82 degrees C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat; continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
- .8 Glycol Systems:
  - .1 In addition to procedures specified above perform specified procedures.
  - .2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

### 3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

- .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
- .5 Clean out strainers repeatedly until system is clean.
- .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems .
- .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
- .8 Repeat with water at design temperature.
- .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
- .10 Bring system up to design temperature and pressure slowly over a 48 hour period .
- .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .12 Adjust pipe supports, hangers, springs as necessary.
- .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .16 Check operation of drain valves.
- .17 Adjust valve stem packings as systems settle down.
- .18 Fully open balancing valves (except those that are factory-set).
- .19 Check operation of over-temperature protection devices on circulating pumps.
- .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### **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**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for piping, valves and fittings for gas fired equipment.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  - .4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B75M-99, Standard Specification for Seamless Copper Tube Metric.
  - .4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
  - .1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.
  - .2 CAN/CSA B149.2-00, Propane Storage and Handling Code.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
  - .2 Indicate on manufacturers catalogue literature following: valves .

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals .

#### **1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.

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

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

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**Part 2 Products**

**2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
  - .1 NPS 1/2 to 2, screwed.
  - .2 NPS 2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

**2.2 JOINTING MATERIAL**

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Brazing: to ASTM B837.

**2.3 FITTINGS**

- .1 Steel pipe fittings, screwed, flanged or welded:
  - .1 Malleable iron: screwed, banded, Class 150.
  - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
  - .3 Welding: butt-welding fittings.
  - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
  - .5 Bolts and nuts: to ASME B18.2.1.
  - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
  - .1 Cast copper fittings: to ASME B16.18.
  - .2 Wrought copper fittings: to ASME B16.22.

**2.4 VALVES**

- .1 Provincial Code approved, lubricated plug /ball type.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

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**3.2 PIPING**

- .1 Install in accordance with Section 23 05 05 - Installation of Pipework, applicable Provincial/Territorial Codes, CAN/CSA B149.1, supplemented as specified.
- .2 Install drip points:
  - .1 At low points in piping system.
  - .2 At connections to equipment.

**3.3 VALVES**

- .1 Install valves with stems upright or horizontal unless otherwise approved by Contract Administrator.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

**3.4 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
  - .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 at stages listed:
    - .1 After delivery and storage of products, and when preparatory work on which 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 work, after cleaning is carried out.
- .3 Obtain reports within three (3) days of review and submit immediately to Contract Administrator.

- .4 Performance Verification:
  - .1 Refer to Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
- .5 PV procedures:
  - .1 Test performance of components.

### **3.5 ADJUSTING**

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.
- .2 Pre-Start-Up Inspections:
  - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
  - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

### **3.6 CLEANING**

- .1 Cleaning: in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems CAN/CSA B149.1 supplemented as specified.
- .2 Perform cleaning operations as specified in accordance with manufacturer's recommendations.
- .3 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC)
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-B214-07, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers' Association (NEMA)
  - .1 NEMA MG 1-2006, Motors and Generators.

**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 Shop Drawings:
  - .1 Provide drawings stamped and signed by Professional Engineer registered or licensed in Province of Manitoba, Canada.
- .4 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                MAINTENANCE**

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

**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.
- .3 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 EQUIPMENT**

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

### **2.2 IN-LINE CIRCULATORS**

- .1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.
- .2 Impeller: alloy cast iron, stainless steel or corrosion resistant 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 self-aligning.
- .6 Capacity: as indicated.
- .7 Design pressure: 860 kPa.

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## 2.3 VERTICAL IN-LINE CIRCULATORS

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: corrosion resistant steel or cast iron.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135 degrees C.
- .5 Coupling: flexible self-aligning.
- .6 Capacity: as indicated .
- .7 Design pressure: 1200 kPa.

## 2.4 SINGLE SUCTION CENTRIFUGAL PUMP

- .1 General: all iron, cast steel or all stainless steel pump complete with motor.
- .2 Base: common cast iron/ fabricated steel with drip rim and tapping for drain connection.
- .3 Volute: cast iron radially split, end suction, flanged suction and discharge, with drain plug and vent cock, suction and discharge pressure gauge tappings.
- .4 Impeller: cast iron/ stainless steel, keyed drive with locking nut or screw.
- .5 Shaft: stainless steel with two point support, machined shoulders for ball bearing mounting sleeve bearings hardened wear rings at packing gland .
- .6 Seal assembly: mechanical seal, grease lubricated.
- .7 Coupling: flexible self-aligning.
- .8 Capacity: as indicated.
- .9 Design pressure: 1200 kPa.

## Part 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 Install hydronic pumps to: CSA-B214.
- .2 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.
- .3 Base mounted type: supply templates for anchor bolt placement.
  - .1 Include anchor bolts with sleeves. Place level, shim unit and grout.
  - .2 Align coupling in accordance with manufacturer's recommended tolerance.
- .4 Ensure that pump body does not support piping or equipment.
  - .1 Provide stanchions or hangers for this purpose.
  - .2 Refer to manufacturer's installation instructions for details.
- .5 Pipe drain tapping to floor drain.
- .6 Install volute venting pet cock in accessible location.
- .7 Check rotation prior to start-up.
- .8 Install pressure gauge test cocks.

### 3.3 START-UP

- .1 General:
  - .1 In accordance with Section 01 91 00 – LEED Commissioning.
  - .2 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 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .4 Check base for free-floating, no obstructions under base.
  - .5 Run-in pumps for 12 continuous hours minimum.
  - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  - .7 Eliminate air from scroll casing.
  - .8 Adjust water flow rate through water-cooled bearings.
  - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
  - .10 Adjust alignment of piping and conduit to ensure true flexibility.
  - .11 Eliminate cavitation, flashing and air entrainment.
  - .12 Adjust pump shaft seals, stuffing boxes, glands.
  - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
  - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

### 3.4 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 Verify performance in accordance with Section 01 91 00 – LEED Commissioning.

.2 Verify that manufacturer's performance curves are accurate.

.3 Ensure valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):

.1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in Section 01 91 00 – LEED Commissioning.

.3 Where procedures do not exist, discontinue PV, report to Contract Administrator and await instructions.

.5 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.7 Commissioning Reports: in accordance with Section 01 91 00 – LEED Commissioning. Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Use Report Forms specified in Section 01 91 00 – LEED Commissioning.

.3 Pump performance curves (family of curves).

### 3.5 CLEANING

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

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

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

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

.1 Section Includes:

.1 Materials and installation for copper tubing and fittings for refrigerant.

**1.2 REFERENCES**

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.22-01, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.

.2 ASME B16.24-02, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.

.3 ASME B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.

.4 ASME B31.5-01, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM B280-03, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)

.1 CSA B52-99, Mechanical Refrigeration Code.

.4 Environment Canada (EC)

.1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals .

## 1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## Part 2 Products

### 2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
  - .1 Hard copper: to ASTM B280, type ACR B.
  - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

## 2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
- .2 Brazed:
  - .1 Fittings: wrought copper to ASME B16.22.
  - .2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
- .3 Flanged:
  - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
  - .2 Gaskets: suitable for service.
  - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .4 Flared:
  - .1 Bronze or brass, for refrigeration, to ASME B16.26.

## 2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

## 2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## Part 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.

### 3.3 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

### 3.4 PIPING INSTALLATION

.1 General:

.1 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Hot gas lines:

.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.

.3 Provide inverted deep trap at top of risers.

.4 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified.

.2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

### 3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

.3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

### 3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.



- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
  - .1 Twice to 14 Pa absolute and hold for 4 h.
  - .2 Break vacuum with refrigerant to 14 kPa.
  - .3 Final to 5 Pa absolute and hold for at least 12 h.
  - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
  - .5 Submit test results to Contract Administrator.
- .7 Charging:
  - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
  - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
  - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
  - .2 Record and report measurements to Contract Administrator.
- .9 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 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 three (3) days of review, and submit, immediately, to Contract Administrator.

### 3.7 DEMONSTRATION

- .1 Instructions:
  - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

**3.8 CLEANING**

- .1 Perform cleaning operations as specified in accordance with manufacturer's recommendations.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**Part 1            General**

**1.1                SUMMARY**

- .1 Section Includes:
  - .1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment system.

**1.2                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).

**1.3                SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .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 manufacturer.

## **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 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 MANUFACTURER**

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

### **2.2 POT FEEDER**

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

### **2.3 CHEMICAL FEED PIPING**

- .1 Resistant to chemicals employed.

### **2.4 CHEMICAL FEED PUMPS**

- .1 Top-mounted electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.

- .2 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 SOFTENER**

- .1 General: 1 sodium zeolite exchanger with common brine tank with eductor and manifold.
- .2 Performance: to reduce effluent hardness to less than 1 ppm.
- .3 Control:
  - .1 Automatic feature to prevent regeneration of both exchangers at same time.
  - .2 Individual metres with solenoid operated diaphragm valves to regenerate unit.
  - .3 Seven day clock permitting regeneration as required. Provide for adjustment of brine/rinse and backwash cycles.

## **2.9 WATER TREATMENT FOR HYDRONIC SYSTEMS**

- .1 Hot water heating system: pot feeder, 25 L.
- .2 Glycol system: pot feeder, 25 L.
- .3 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.

## **2.10 CHEMICALS**

- .1 Provide one (1) year supply.
- .2 Obtain chemicals from manufacturer with existing valid contract with DND.

## **2.11 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.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install 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 SYSTEM**

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Contract Administrator.
- .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 WATER TREATMENT SERVICES**

- .1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

- .1 Initial water analysis and treatment recommendations.
- .2 System start-up assistance.
- .3 Operating staff training.
- .4 Visit plant every seven (7) days during period of operation and as required until system stabilizes, and advise on treatment system performance.
- .5 Provide necessary recording charts and log sheets for one (1) year operation.
- .6 Provide necessary laboratory and technical assistance.
- .7 Provide clear, concise, written instructions and advice to operating staff.

### **3.6 WATER SOFTENER**

- .1 Install in accordance with manufacturer's instructions.
- .2 Install water metre in water softener inlet piping.

### **3.7 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 and 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 water analysis.
    - .4 Required quality of treated water.
  - .4 Commissioning procedures - applicable to Water Treatment Systems:
    - .1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
    - .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
    - .3 Establish test intervals, regeneration intervals.

- .4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
- .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
- .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
- .7 Advise Contract Administrator in writing on matters regarding installed water treatment systems.
- .5 Commissioning procedures - Water Softeners:
  - .1 Demonstrate compliance with specifications by chemical analyses of raw water and treated water.
  - .2 Determine, demonstrate actual softening capacity between regenerations.
  - .3 Establish regeneration intervals and procedures.
  - .4 Train O&M personnel in regeneration procedures.
- .6 Commissioning procedures - Closed Circuit Hydronic Systems:
  - .1 Analyze water in system.
  - .2 Based upon an assumed rate of loss approved by Contract Administrator, establish rate of chemical feed.
  - .3 Record types, quantities of chemicals applied.
- .7 Training:
  - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
  - .2 Train O&M personnel in softener regeneration procedures.
- .8 Certificates:
  - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .9 Commissioning Reports:
  - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Contract Administrator.
- .10 Commissioning activities during Warranty Period:
  - .1 Check out water treatment systems on regular basis and submit written report to Contract Administrator.

### 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



**Part 1 General**

**1.1 SUMMARY**

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

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association (NFPA).
  - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 96-01, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.
- .7 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

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### 1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials for the following:
  - .1 Sealants.
  - .2 Tape.
  - .3 Proprietary Joints.

### 1.4 QUALITY ASSURANCE

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

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## Part 2 Products

### 2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

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

- .2 Seal classification:

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

### 2.2 SEALANT

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

### 2.3 TAPE

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

### 2.4 DUCT LEAKAGE

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

### 2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
- .1 Rectangular: standard radius short radius with single thickness turning vanes  
Centreline radius: 1.5 times width of duct.
  - .2 Round: smooth radius five piece. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
- .1 To 400 mm: with single thickness turning vanes.
  - .2 Over 400 mm: with double thickness turning vanes.

- .4 Branches:
  - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct.
  - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
  - .3 Provide volume control damper in branch duct near connection to main duct.
  - .4 Main duct branches: with splitter damper.
- .5 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
  - .1 Short radiused elbows or as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.

## **2.6 FIRE STOPPING**

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

## **2.7 GALVANIZED STEEL**

- .1 Lock forming quality: to ASTM A653/A653M, 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 .

## **2.8 STAINLESS STEEL**

- .1 To ASTM A480/A480M, Type 304.
- .2 Finish: No. 4.
- .3 Thickness, fabrication and reinforcement: to SMACNA.
- .4 Joints: to SMACNA be continuous inert gas welded.

## **2.9 ALUMINUM**

- .1 To SMACNA. Aluminum type: 3003-H-14.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA be continuous weld.

## 2.10 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: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

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

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

## 2.11 BLACK STEEL

.1 To ASTM A635/A635M.

.2 Thickness: 1.2 mm or as indicated.

.3 Fabrication: ducts and fittings to ASHRAE SMACNA.

.4 Reinforcement: as indicated.

.5 Joints: continuous weld.

## 2.12 KITCHEN EXHAUST SYSTEM

.1 Construct in accordance with NFPA 96.

.2 Material: Type stainless steel or black steel, as per NFPA 96.

.3 Thickness: as per NFPA 96.

.4 Fabrication: as per NFPA 96.

.5 Reinforcement: as per NFPA 96.

.6 Drainage: as requested.

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**Part 3 Execution**

**3.1 GENERAL**

- .1 Do work in accordance with ASHRAE or SMACNA as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions .
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

**3.2 HANGERS**

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

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

**3.3 KITCHEN EXHAUST SYSTEMS**

- .1 Install to NFPA 96 and as indicated.

**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 (1) coat of sealant to manufacturers recommendations.

**END OF SECTION**

**Part 1            General**

**1.1                SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

**1.2                REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

**1.3                SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.
  - .2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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## 1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## Part 2 Products

### 2.1 GENERAL

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

### 2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:



- .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m<sup>2</sup>.

## 2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks complete with safety chain.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two (2) handles operable from both sides.
  - .5 Hold open devices.
  - .6 300 x 300 mm glass viewing panels.

## 2.4 TURNING VANES

- .1 Factory or shop fabricated single thickness without trailing edge , to recommendations of SMACNA and as indicated.

## 2.5 INSTRUMENT TEST

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

## 2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

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**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
  - .1 Size:
    - .1 450 x 450 mm for servicing entry.
    - .2 300 x 300 mm for viewing.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils.
    - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .2 Locate to permit easy manipulation of instruments.
  - .3 Install insulation port extensions as required.
  - .4 Locations:
    - .1 For traverse readings:
      - .1 Ducted inlets to roof and wall exhausters.
      - .2 Inlets and outlets of other fan systems.

- .3 Main and sub-main ducts.
- .4 And as indicated.
- .2 For temperature readings:
  - .1 At outside air intakes.
  - .2 In mixed air applications in locations as approved by Contract Administrator.
  - .3 At inlet and outlet of coils.
  - .4 Downstream of junctions of two converging air streams of different temperatures.
  - .5 And as indicated.
- .4 Turning vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.

### 3.3 CLEANING

- .1 Perform cleaning operations as specified in Section 01 74 11- Cleaning and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1            General**

**1.1                SUMMARY**

- .1 Section Includes:
  - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

**1.2                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).

**1.3                SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 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.

**1.4                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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.

- .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
  - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
- .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
  - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
  - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
  - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Manufacture to SMACNA standards.

### **2.2 SPLITTER DAMPERS**

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Single thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

### **2.3 SINGLE BLADE DAMPERS**

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

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## **2.4 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.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

## **Part 3 Execution**

### **3.1 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 Contract Administrator.

### **3.3 FIELD QUALITY CONTROL**

- .1 Tests:
  - .1 Tests to cover period of not less than 7 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**

**Part 1            General**

**1.1                SUMMARY**

- .1 Section Includes:
  - .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

**1.2                REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3                SUBMITTALS**

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

**1.4                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.



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## 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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## Part 2 Products

### 2.1 MULTI-LEAF DAMPERS

- .1 Opposed 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 0.5% of rated air flow at 250 Pa differential across damper.
  - .2 Pressure drop: at full open position less than 20 Pa differential across damper at 5.08 m/s.
- .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.

## **2.2 BACK DRAFT DAMPERS**

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, counterweighted.

## **2.3 RELIEF DAMPERS**

- .1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at 20 Pa static pressure.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

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

### **3.3 CLEANING**

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

END OF SECTION

**Part 1            General**

**1.1                SUMMARY**

.1            Section Includes:

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

**1.2                REFERENCES**

.1            American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

- .1            ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2            Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1            Material Safety Data Sheets (MSDS).

.3            Underwriters Laboratories of Canada (ULC)

- .1            CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
- .2            CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .3            ULC-S505-1974, Fusible Links for Fire Protection Service.

**1.3                SUBMITTALS**

.1            Product Data:

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

- .1            Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2            Indicate the following:

- .1            Fire dampers.
- .2            Smoke dampers.
- .3            Fire stop flaps.
- .4            Operators.
- .5            Fusible links.
- .6            Design details of break-away joints.

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

- .1            Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2            Instructions: submit manufacturer's installation instructions.

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

#### **1.4            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.

#### **1.5            MAINTENANCE**

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

#### **1.6            DELIVERY, STORAGE, AND HANDLING**

- .1    Packing, shipping, handling and unloading:
  - .1    Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2    Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2    Waste Management and Disposal:
  - .1    Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2    Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3    Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1    Low-Emitting Materials: Adhesives and Sealants.
    - .1    Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4    Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1    Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2    VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3    Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

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**Part 2            Products**

**2.1                FIRE DAMPERS**

- .1      Fire dampers: curtain type with the blade out of the air stream, arrangement listed and bear label of ULC, meet requirements of provincial fire authority Fire Commissioner of Canada (FCC), 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: fire rated to match or exceed assembly rating 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      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.
- .4      40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .5      Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .6      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.
- .7      Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .8      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.
- .9      Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

**2.2                FIRE STOP FLAPS**

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

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**Part 3            Execution**

**3.1                MANUFACTURER'S INSTRUCTIONS**

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

**3.2                INSTALLATION**

- .1            Install in accordance with 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**

**Part 1            General**

**1.1                SUMMARY**

.1            Section Includes:

.1            Materials and installation of flexible ductwork, joints and accessories.

**1.2                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            National Fire Protection Association (NFPA).

.1            NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2            NFPA 90B-02, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.5            Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

.1            SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 (Addendum No.1, November 1997).

.2            SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

.6            Underwriters' Laboratories Inc. (UL).

.1            UL 181-96, Standard for Factory-Made Air Ducts and Air Connectors.

.7            Underwriters' Laboratories of Canada (ULC).

.1            CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

**1.3                SUBMITTALS**

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

.2            Product Data: submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials for the following:

.1            Thermal properties.

.2            Friction loss.

.3            Acoustical loss.

- .4 Leakage.
- .5 Fire rating.
- .3 Samples: submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00 - Submittal Procedures.

#### **1.4 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.

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

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

#### **1.6 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN**

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

### **Part 2 Products**

#### **2.1 GENERAL**

- .1 Factory fabricated to CAN/ULC-S110.



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

## 2.2 METALLIC - UNINSULATED

- .1 Type 1: spiral wound flexible stainless steel, as indicated.
- .2 Performance:
  - .1 Factory tested to 2.5 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

## 2.3 METALLIC - INSULATED

- .1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl reinforced mylar/neoprene laminate jacket, as indicated.
- .2 Performance:
  - .1 Factory tested to 2.5 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

## 2.4 NON-METALLIC - UNINSULATED

- .1 Type 3: non-collapsible, coated aluminum foil mylar type, mechanically bonded to, and helically supported by, external steel wire, as indicated.
- .2 Performance:
  - .1 Factory tested to 2.5 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

## 2.5 NON-METALLIC - INSULATED

- .1 Type 4: non-collapsible, coated aluminum foil/mylar type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl reinforced mylar/neoprene laminate jacket, as indicated.
- .2 Performance:
  - .1 Factory tested to 2.5 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

## Part 3 Execution

### 3.1 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110, NFPA 90A NFPA 90B and SMACNA.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Materials and installation for acoustic duct lining.

**1.2                REFERENCES**

- .1        American Society for Testing and Materials International, (ASTM).
  - .1        ASTM C423-02a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2        ASTM C916-85(2001)e1, Standard Specification for Adhesives for Duct Thermal Insulation.
  - .3        ASTM C1071-00, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - .4        ASTM C1338-00, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .5        ASTM G21-96(2002), Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2        Department of Justice Canada (Jus).
  - .1        Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .3        Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1        Material Safety Data Sheets (MSDS).
- .4        National Fire Protection Association (NFPA).
  - .1        NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.
  - .2        NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .5        North American Insulation Manufacturers Association (NAIMA).
  - .1        NAIMA AH116-5th Edition, Fibrous Glass Duct Construction Standards.
- .6        Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
  - .1        SMACNA, HVAC DCS, HVAC, Duct Construction Standards, Metal and Flexible-95 (Addendum No.1, Nov. 97).
  - .2        SMACNA IAQ Guideline for Occupied Buildings 95.
- .7        Transport Canada (TC).
  - .1        Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .8        Underwriter's Laboratories of Canada (ULC).
  - .1        CAN/ULC-S102-03-EN, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### 1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

### 1.4 DELIVERY, STORAGE AND HANDLING

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

### 1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
- .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
  - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
- .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
  - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
  - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
  - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## Part 2 Products

### 2.1 DUCT LINER

- .1 General:
  - .1 Mineral Fibre duct liner: air surface coated mat facing.
  - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102, NFPA 90A and NFPA 90B.
  - .3 Recycled Content: EcoLogo certified with minimum 35 % by weight recycled content.
  - .4 Fungi resistance: to ASTM C1338.
- .2 Rigid:

- .1 Use on flat surfaces.
  - .2 25 mm thick, to ASTM C1071, Type 2 , fibrous glass rigid board duct liner.
  - .3 Density: 48 kg/m<sup>3</sup> minimum.
  - .4 Thermal resistance to be minimum 0.76 (m<sup>2</sup>.degrees C)/W for 25 mm thickness, 1.15 (m<sup>2</sup>.degrees C)/W for 38 mm thickness and 1.53 (m<sup>2</sup>.degrees C)/W for 50 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
  - .5 Maximum velocity on faced air side: 20.3 m/sec.
  - .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.
  - .7 Recycled Content: EcoLogo certified containing minimum 45 % by weight recycled content .
- .3 Flexible:
- .1 Use on round or oval surfaces.
  - .2 25 mm thick, to ASTM C1071 Type 1 , fibrous glass blanket duct liner.
  - .3 Density: 24 kg/m<sup>3</sup> minimum.
  - .4 Thermal resistance to be minimum 0.37 (m<sup>2</sup>.degrees C)/W for 12 mm thickness, 0.74 (m<sup>2</sup>.degrees C)/W for 25 mm thickness and 1.11 (m<sup>2</sup>.degrees C)/W for 38 mm thickness 1.41 (m<sup>2</sup>.degrees C)/W to 50 mm thickness when tested in accordance with ASTM C177 , at 24 degrees C mean temperature.
  - .5 Maximum velocity on coated air side: 5.08 m/sec.
  - .6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C423.

## 2.2 ADHESIVE

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

## 2.3 FASTENERS

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

## 2.4 JOINT TAPE

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

## 2.5 SEALER

- .1 Meet requirements of NFPA 90A and NFPA 90B.

- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

### **Part 3 Execution**

#### **3.1 GENERAL**

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

#### **3.2 DUCT LINER**

- .1 Install in accordance with manufacturer's recommendations, and as follows:
  - .1 Fasten to interior sheet metal surface with 100 % coverage of adhesive to ASTM C916
    - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
  - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.

#### **3.3 JOINTS**

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

**END OF SECTION**

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**Part 1            General**

**1.1                SUMMARY**

.1            Section Includes:

- .1            Fans, motors, accessories and hardware for commercial use.

**1.2                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).

**1.3                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            Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .3            Sound ratings: comply with AMCA 301, tested to AMCA 300.
- .4            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.

**1.4                SUBMITTALS**

.1            Product Data:

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

- .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .3 Provide:
  - .1 Fan performance curves showing point of operation, BHP 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.

## 1.5 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 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 FANS GENERAL**

- .1 Motors:
  - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
  - .2 Motors, 1 HP and larger rated for use with variable speed controllers.
  - .3 Sizes as indicated/specified.
  - .4 Two speed with two windings and speeds as indicated.
  - .5 Two speed with split winding, constant horsepower constant or variable torque and speeds as specified.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and 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 Scroll casing drains: as indicated.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

- .6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

## 2.2 CENTRIFUGAL FANS

- .1 Fan wheels:
  - .1 Welded steel, aluminum construction.
  - .2 Maximum operating speed of centrifugal fans not more than 40 % of first critical speed.
- .2 Bearings: heavy duty 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, cast iron, steel, aluminum, 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 bolted airtight access doors with handles.
- .4 Variable volume control devices:
  - .1 Mounted by fan manufacturer, where specified.
  - .2 Adjustable inlet vanes: operated from a centre mechanism linked to each damper vane. Support each vane at ends in bronze bearings . On DWDI fans interconnect vanes to operate in unison. Provide locking devices for manual operation.

## 2.3 CABINET FANS - GENERAL PURPOSE

- .1 Fan characteristics and construction: as centrifugal fans.
- .2 Casing floor mounted, Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, V-belt drive and guard inside or outside casing.
- .3 Fabricate casing of zinc coated or phosphate treated steel reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181. Finish inside and out, over prime coat, with rust resistant enamel.

## 2.4 UTILITY SETS

- .1 Characteristics and construction: for centrifugal fans.
- .2 Preassemble single width centrifugal fan with removable weatherproof protective hood with vents, and automatic spring loaded back draft dampers and 12 mm mesh bird screens.
- .3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

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## **2.5 IN-LINE CENTRIFUGAL FANS**

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

## **2.6 PROPELLER FANS**

- .1 Fabricate multibladed propellers of sheet steel or aluminum of airfoil shape within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, direct or belt driven, complete with motor as indicated.
- .2 Provide blade guards, bird screen and automatic back draft dampers on discharge, with gasketed edges.

## **Part 3 Execution**

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

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

### **3.2 FAN INSTALLATION**

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

### **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**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Roof and wall exhausters.

**1.2 REFERENCES**

- .1 Air Movement and Control Association (AAMC)
  - .1 AMCA Publication 99-2003, Standards Handbook (Revised 2003).
  - .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)
  - .1 ANSI/AMCA 210-99, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3 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. Provide confirmation of testing.
  - .2 Statically and dynamically balanced. Constructed to AMCA 99.
  - .3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal .
  - .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, unit to bear AMCA certified rating seal .
  - .5 Bearings: heavy duty grease lubricated ball or roller bearings of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.

**1.4 SUBMITTALS**

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

- .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
  - .2 Include:
    - .1 Fan performance curves showing specified point of operation.
    - .2 Sound rating data.
- .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 operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## 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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.

- .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
- .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

**1.6 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.

**Part 2 Products**

**2.1 ROOF EXHAUSTERS**

- .1 Centrifugal V belt, direct driven.
  - .1 Housings: spun aluminum, galvanized, black steel complete with resilient mounted motor and fan.
  - .2 Impeller: aluminum non-overloading.
  - .3 Adjustable motor sheave.
  - .4 12 mm mesh 2.0 mm diameter aluminum birdscreen.
  - .5 Automatic gasketed aluminum backdraft dampers.
  - .6 Disconnect switch within fan housing.
  - .7 Continuous curb gaskets, cadmium plated securing bolts and screws, and special mated sound insulating 300 mm high curbs where indicated. Hinge curb plate for access to internals for maintenance.
- .2 Eisenheiss coated wheel and upblast discharge for fume hood service with motor out of air stream.
- .3 Sound curbs: of same manufacturer as fan and built to suit model specified.

	.1	Double baffle and self-flashing type. Required decibel sound attenuation spectrum:							
Frequency Octave Band		1	2	3	4	5	6	7	8
dB Attenuation		3	5	11	16	22	20	17	13

- .2 Pressure loss through curbs: 37 Pa max at rated L/s.

**2.2 WALL EXHAUSTERS**

- .1 Centrifugal backward inclined or Axial fan units, V belt driven.

- .1 Spun aluminum housings, complete with resilient mounted motor and fan.
- .2 12 mm mesh 2.0 mm diameter aluminum birdscreen.
- .3 Automatic gasketted aluminum backdraft dampers.
- .4 Disconnect switch within fan housing.
- .5 Cadmium plated securing bolts and screws.
- .2 Eisenheiss coated wheel for fume service with motor out of air stream.
- .3 Housings:
  - .1 Provide with rubber or neoprene grommets for wiring passages, integral attachment collar, or angle ring mounted to mating flanged wall sleeve with full gasketting.
  - .2 Discharge pattern: away from building.

### **Part 3 Execution**

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

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

#### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.

#### **3.3 ANCHOR BOLTS AND TEMPLATES**

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

#### **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**



**Part 1            General**

**1.1                SUMMARY**

- .1    Section Includes:
  - .1    Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

**1.2                SYSTEM DESCRIPTION**

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

**1.3                SUBMITTALS**

- .1    Product Data:
  - .1    Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures . Include product characteristics, performance criteria, and limitations.
    - .1    Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures .
  - .2    Indicate following:
    - .1    Capacity.
    - .2    Throw and terminal velocity.
    - .3    Noise criteria.
    - .4    Pressure drop.
    - .5    Neck velocity.
    - .6    Optional color codes.
- .2    Samples:
  - .1    Submit samples in accordance with Section 01 33 00 - Submittal Procedures
  - .2    Samples are required for following:
    - .1    Diffusers, registers and grilles – 1 of each type.
- .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.

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## **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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **1.5 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Include:
    - .1 Keys for volume control adjustment.
    - .2 Keys for air flow pattern adjustment.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated. Maximum noise criteria for individual diffusers, registers and grilles in NC30.
- .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 Contract Administrator.

## **2.2 MANUFACTURED UNITS**

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

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head, stainless steel screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
- .4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms.

### **3.3 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

.1 Section Includes:

- .1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.

**1.2 REFERENCES**

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)

- .1 ANSI/NFPA 96-04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society for Testing and Materials International (ASTM)

- .1 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.5 Society of Automotive Engineers (SAE)

**1.3 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.

**1.4 SUBMITTALS**

.1 Product Data:

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

- .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following:

- .1 Pressure drop.
- .2 Face area.
- .3 Free area.

- .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 Test Reports:
  - .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

## **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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS**

- .1 Factory manufactured aluminum.
  - .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire.

- .2 Horizontal motorized dampers in throat, provide hinged access doors for linkage and activators.
  - .3 Maximum throat velocity: 3.3 m/s intake.
  - .4 Maximum loss through unit: 15 Pa exhaust static pressure.
  - .5 Maximum velocity through damper area: 1.5 m/s.
  - .6 Shape: as indicated.
- .2 Birdscreens:
- .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust 19 mm mesh on intake.

## 2.2 GOOSENECK HOODS

- .1 Thickness: to ASHRAE and SMACNA.
  - .1 Kitchen: to ANSI/NFPA 96.
  - .2 Elsewhere: to ASHRAE/SMACNA.
- .2 Fabrication: to ASHRAE and SMACNA.
  - .1 Kitchen: to ANSI/NFPA 96.
  - .2 Elsewhere: to ASHRAE/SMACNA.
- .3 Joints: to ASHRAE and SMACNA and proprietary manufactured duct joint. Proprietary manufactured flanged duct joint considered class A seal.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust 19 mm mesh on intake.
- .6 Backdraft dampers on four (4) faces.

## 2.3 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

- .7 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: prime coated anodized. Colour: to Contract Administrator approval.

## **2.4 ADJUSTABLE LOUVRES**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: prime coated anodized. Colour: to Contract Administrator approval.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

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

### **3.3 CLEANING**

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

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Filters and filter gauges for various types of mechanical air handling equipment.

**1.2 REFERENCES**

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
  - .1 ANSI/NFPA 96-04, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 52.1-1992, 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-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.
  - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.
  - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll.
  - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
  - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
  - .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
  - .9 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 ULC -S111-95, Standard Method of Fire Tests for Air Filter Units.
  - .1 ULC-S649-1993, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

### 1.3 SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .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.

### 1.4 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 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ - 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,

- .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
  - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
  - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
  - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## 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 Contract Administrator, supply 1 complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals .

## Part 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.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

### 2.2 ACCESSORIES

- .1 Holding frames: permanent "T" section or channel section construction of galvanized steel or extruded aluminum same material as casing/hood, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side or from upstream, downstream face of filter bank.

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**2.3 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: minimum average synthetic dust weight arrestance 70 % to ASHRAE 52.1.
- .4 Fire rated: to ULC -S111.

**2.4 COTTON PANEL FILTERS**

- .1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.
- .2 Holding frame: galvanized steel, or slide in channel for side access.
- .3 Performance:
  - .1 Average atmospheric dust spot efficiency 30 % to ASHRAE 52.1 .
  - .2 Average synthetic dust weight arrestance 90 % to ASHRAE 52.1 .
- .4 Fire Rated: to ULC -S111.

**2.5 GREASE FILTERS**

- .1 Media: washable, 50 mm thick: to ULC- S649 and ANSI/NFPA 96.
- .2 Holding frame: 1 mm thick stainless steel V or inclined as indicated.
- .3 Stainless steel blank-off plates.
- .4 Individual, removable drip trays with handles.

**2.6 RIGID, SUPPORTED BAG TYPE FILTERS, 30-35 % EFFICIENCY**

- .1 Media: disposable preformed fibrous glass, acrylic fibre synthetic media cartridge.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.
- .4 Performance:
  - .1 Average atmospheric dust spot efficiency 30 % to ASHRAE 52.1.
  - .2 Average synthetic dust weight arrestance 90 % to ASHRAE 52.1.
- .5 Fire rated: to ULC -S111.

**2.7 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: average atmospheric dust spot efficiency 80-85 % to ASHRAE 52.1 .
- .5 Fire rated: to ULC -S111.

**2.8 CARTRIDGE TYPE FILTERS 95 % EFFICIENCY**

- .1 Media: disposable, high efficiency, to CAN/CGSB-115.15.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.
- .4 Performance: average atmospheric dust spot efficiency 95 % to ASHRAE 52.1 .
- .5 Fire rated: to ULC-S111.

**2.9 BAG TYPE FILTERS, 80-85% EFFICIENCY**

- .1 Disposable media bag type of self-inflating ultrafine glass:
  - .1 High efficiency to CAN/CGSB-115.11.
  - .2 Medium efficiency to CAN/CGSB-115.12.
- .2 Holding frame: galvanized steel.
- .3 Media support: welded galvanized steel.

**2.10 FILTER GAUGES - DIAL TYPE**

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure 0 to 250 Pa.

**2.11 FILTER GAUGES - MANOMETER TYPE**

- .1 Inclined acrylic tube.
- .2 Complete with levelling screws.
- .3 Range: 0 to 2 times initial pressure 0 to 250 Pa.

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**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION 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 FILTER GAUGES**

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

**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**

**Part 1            General**

**1.1                SUMMARY**

.1            Section Includes:

.1            Heating boiler units:

**1.2                REFERENCES**

.1            American Boiler Manufacturer's Association (ABMA)

.2            American National Standards Institute (ANSI)

.1            ANSI Z21.13-2004/CSA 4.9-2004, Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.3            American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)

.1            ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.

.4            Canadian Gas Association (CGA)

.1            CAN1-3.1-77(R2001), Industrial and Commercial Gas-Fired Package Boilers.

.2            CAN/CSA-B149.1-05, Natural Gas and Propane Installation Code.

.5            Canadian Standards Association (CSA International)

.1            CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

.2            CSA B139-04, Installation Code for Oil Burning Equipment.

.3            CSA B140.7-05, Oil Burning Equipment: Steam and Hot-Water Boilers.

.6            Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.7            Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1            Material Safety Data Sheets (MSDS).

**1.3                SUBMITTALS**

.1            Product Data:

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

.1            Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2            Shop Drawings:

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

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .2 Indicate the following:
  - .1 General arrangement showing terminal points, instrumentation test connections.
  - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
  - .3 Foundations with loadings, anchor bolt arrangements.
  - .4 Piping hook-ups.
  - .5 Equipment electrical drawings.
  - .6 Burners and controls.
  - .7 All miscellaneous equipment.
  - .8 Flame safety control system.
  - .9 Breeching and stack configuration.
  - .10 Stack emission continuous monitoring system to measure CO, O<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, stack temperature and smoke density of flue gases .
- .3 Engineering data to include:
  - .1 Boiler efficiency at 25%, 50%, 75%, 100%, and 110% of design capacity.
  - .2 Radiant heat loss at 100% design capacity.
- .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 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA and applicable Provincial regulations.

#### **1.5 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 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## 1.6 MAINTENANCE

- .1 Extra materials:
  - .1 Special tools for burners, manholes, handholes and Operation and Maintenance.
  - .2 Spare parts for 1 year of operation.
  - .3 Spare gaskets.
  - .4 Spare gauge glass inserts.
  - .5 Probes and sealants for electronic indication.
  - .6 Spare burner tips.
  - .7 Spare burner gun.
  - .8 Safety valve test gauge.

## Part 2 Products

### 2.1 GENERAL

- .1 Packaged boiler:
  - .1 Complete with burner and necessary accessories and controls.
  - .2 Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA B140.7 CAN1-3.1, witnessed and certified by Contract Administrator.
  - .3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.
  - .4 Designed and constructed to ANSI/ASME Boiler and Pressure vessel Code.
  - .5 CRN (Canadian Registration Number), to CSA B51.

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- .6 Boiler/burner package to bear ULC CGA label.
  - .2 Performance:
    - .1 In accordance with American Boiler Manufacturers Association (ABMA), or ANSI Z21.13/CSA 4.9 (gas burning) testing procedures.
    - .2 Boiler efficiency: 80 % minimum at 30% to 100% firing rates.
    - .3 Flue gas temperature leaving boiler:
      - .1 Not to exceed 260 degrees C.
      - .2 Above dewpoint conditions at minimum firing rate.
  - .3 Electrical:
    - .1 Electrical components: CSA approved.
  - .4 Controls: factory wired. Enclosed in Electrical and Electronic Manufacturers' Association of Canada (EEMAC) 1 steel cabinet.
  - .5 Thermal insulation:
    - .1 50 mm thick mineral fibre. Seal insulation at handholes, manholes, mudholes, piping connections with insulating cement or asphaltic paint. Finish with heat resisting paint.
  - .6 Jackets: heavy gauge metal, finished with heat resisting paint.
  - .7 Mounting:
    - .1 Structural steel base, lifting lugs.
  - .8 Anchor bolts and templates:
    - .1 Supply for installation by other Divisions. Anchor bolts to be sized to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
  - .9 Start-up, instruction, on-site performance tests: 3 days per boiler.
  - .10 Trial usage:
    - .1 Contract Administrator may use boilers for test purposes prior to acceptance and commencement of warranty period.
    - .2 Supply labour, materials and instruments required for tests.
  - .11 Temporary use by contractor:
    - .1 Contractor may use boilers only after written approval from Contract Administrator.
    - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
    - .3 Refurbish to as-new condition before final inspection and acceptance.

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**2.2 MODULAR HOT WATER BOILER, NATURAL GAS PULSE FIRED, CONDENSING TYPE**

- .1 Heating boiler seasonal efficiency rating: 90 %. Flue gas exhaust temperature: 45 to 55 degrees C, when operating in condensing mode.
- .2 Flue gas: individually direct vented. Combustion air: individually drawn from outdoors through plastic pipes as indicated and as recommended by manufacturer.
- .3 Factory-assemble each module to include:
  - .1 Combustion air inlet chamber.
  - .2 Pre-purge blower assembly.
  - .3 Air-gas fuel control valve.
  - .4 Cast pulse combustion chamber.
  - .5 Welded absorption chamber with spiralled fire tubes and exhaust chamber.
  - .6 House assembly in insulated jacket which includes boiler mounted electrical control panel enclosure with operation sequence indicator lights.
  - .7 Provide coupling on combustion air inlet and exhaust chambers for connections of plastic piping, PVC for outside air intake and CPVC for outside exhaust.
  - .8 Provide condensate drain fitting on exhaust chamber.
  - .9 Boiler materials will enable operation with flue gas temperature below dewpoint without corrosion.
- .4 Absorption unit: constructed in accordance with Section IV of ASME Boiler and Pressure Vessel Code for Low Pressure Heating Boilers for 207 kPa working pressure.
- .5 Controls for each module to include:
  - .1 Solid state controller with auxiliary relay.
  - .2 Fan prove pressure switch and pressure sensing flame safeguard system.
  - .3 Provide combination gas control with:
    - .1 Manual shut off valve.
    - .2 System pressure controlled regulator.
    - .3 Automatic redundant shut off valves.
    - .4 High limit water temperature control with adjustable differential.
    - .5 ASME approved pressure relief valve and temperature/pressure indicator.
- .6 Factory wire each module and operationally test.
  - .1 Each module suitable for individual firing.
  - .2 Step firing accomplished by firing individual modules without reducing their thermal efficiency.
  - .3 Control system: designed and provided for heating plant by manufacturer.

**2.3 AUXILIARIES**

- .1 Provide auxiliaries for each boiler and to meet ANSI/ASME requirements.

- .2 Hot water boilers:
  - .1 Relief valves: ANSI/ASME rated, to release entire boiler capacity .
  - .2 Pressure gauge: 90 mm diameter complete with shut-off cock.
  - .3 Thermometer: 115 mm diameter range 10 to 150 degrees C.
  - .4 Low water cut-off: with visual and audible alarms.
  - .5 Auxiliary low water cut-off: with separate cold water connection to boiler.
  - .6 Isolating gate valves: on supply and return connections.
  - .7 Drain valve: NPS 2.
  - .8 Stack thermometer: range 65 to 400 degrees C.
  - .9 Outdoor controller: to reset operating temperature controller.
  - .10 One 1 set of cleaning tools.

## 2.4 GAS BURNERS

- .1 General:
  - .1 Forced draft with:
    - .1 Built-in blower to supply combustion air, complete with motor, silencer and damper.
    - .2 High voltage ignition transformer.
    - .3 Flame observation port.
    - .4 Easy access to nozzles and electrodes.
  - .2 Gas pilot:
    - .1 To building code and provincial regulations including solenoid gas valve, pressure regulator, pressure gauge, manual shut-off valve.
  - .3 Main gas train:
    - .1 To building code and provincial regulations including main shut-off valve, pressure regulator, motorized electric shut-off valve, downstream block-test valve with test connection and pressure gauge.
  - .4 Controls:
    - .1 Electronic combustion control relay with flame rod/ultra-violet/infra-red flame detector for combustion control and flame supervision.
    - .2 Control to shut off fuel within 5 seconds upon pilot flame or main flame failure or upon signal of safety interlock and to ensure, when restarted, in sequence:
      - .1 Pre-purge.
      - .2 Pilot ignition and supervision.
      - .3 Main gas valve opening.
      - .4 Pilot cut-off. Pilot-proving period not to exceed 10 seconds.
      - .5 Burner operation.
      - .6 Post-purge burner shut-down.
    - .3 Static pressure interlock. To shut off burner upon loss of combustion air pressure.

- .4 Fuel-air mixture: control through:
  - .1 2-position motor with end switch to provide for low-fire start and high fire run.
  - .2 Two-position motor with linkage to control fuel and air and with end switches to prove low-fire start and energize high fire solenoid valve for high-low fire operation.
  - .3 Modulating motor with end switch to provide for low-fire start and fully modulating operation down to 20 % of design capacity.
- .5 Immersion controllers:
  - .1 Operating: to start and stop burner, and operating between adjustable setpoints.
  - .2 High-low: to shift burner operation to high or low fire.
  - .3 Modulating: to modulate burner output.
  - .4 High limit: manual reset.
  - .5 Controller range: 30 to 121 degrees C.
- .6 Visual and audible alarms: to indicate burner shutdown due to flame failure, low water level, high pressure/temperature, low air pressure, low gas pressure.
- .7 Selector switch: to permit manual and automatic firing at any rate between low and high fire .
- .8 Pilot lights: to indicate:
  - .1 Normal burner operation.
  - .2 All stages of burner operation.
- .9 Burner to start up in low fire position.

## 2.5 EMISSION CONTROL

- .1 Rate of discharge of air contaminants from boiler not to exceed:
  - .1 For nitrogen oxides expressed as nitrogen dioxide:
    - .1 150 ng/J of heat input when fired with solid fossil fuel.
    - .2 110 ng/J of heat input when fired with oil specified as type 4, 5, or 6, according to CGSB classification.
    - .3 43 ng/J of heat input when fired with oil specified as type 1 or 2, according to CGSB classification.
    - .4 22 ng/J of heat input when fired with gaseous fuel.
  - .2 For sulphur dioxide:
    - .1 500 ng/J of heat input when fired with solid fossil fuel.
    - .2 500 ng/J of heat input when fired with oil specified as type 4, 5 or 6, according to CGSB classification.
    - .3 25 ng/J of heat input when fired with oil specified as type 1 or 2, according to CGSB classification.
  - .3 For particulate matter measured undiluted, 160 mg/m<sup>3</sup>, when fired with solid fossil fuel.
  - .4 For carbon monoxide, 125 ng/J of heat input.

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**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Mount unit level using specified vibration isolation in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .5 Pipe hot water relief valves full size to nearest drain.
- .6 Pipe blowdown/drain to blowdown tank/floor drain.
- .7 Natural gas fired installations - in accordance with CAN/CSA-B149.1.

**3.3 MOUNTINGS AND ACCESSORIES**

- .1 Safety valves and relief valves:
  - .1 Run separate discharge from each valve.
  - .2 Terminate discharge pipe as indicated.
  - .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.
- .2 Blowdown valves:
  - .1 Run discharge to terminate as indicated.

**3.4 FIELD QUALITY CONTROL**

- .1 Commissioning:
  - .1 Manufacturer to:
    - .1 Certify installation.
    - .2 Start up and commission installation.
    - .3 Carry out on-site performance verification tests.
    - .4 Demonstrate operation and maintenance.

- .2 Provide Contract Administrator at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

### **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**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
  - .1 ANSI/ARI 430-99(R2002), Central-Station Air-Handling Units.
- .2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
  - .1 ANSI/ASHRAE 90.1-2007, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-11-07, Environmental Standard for Paints.
- .5 Master Painters Institute (MPI)
  - .1 MPI-INT 5.3-2007, Galvanized Metal.
- .6 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
  - .1 SCAQMD Rule 1113-04, Architectural Coatings.

**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 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
  - .2 Indicate following: fan, fan curves showing point of operation, motor drive, bearings, 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.



- .2 Include following: fan, bearings, motor, damper, air volume, total cooling, sensible cooling, EDB, EWB and OAT.

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one (1) spare set 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 Contract Administrator, supply one (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.
- .3 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
    - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
    - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

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**Part 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 or Vertical type, as indicated, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, dampers bypass section heating coil, cooling coil and mixing box.

**2.2**

**CASINGS**

- .1 Galvanized or Phosphate treated, reinforced and braced for rigidity.
  - .1 Removable panels and 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 units, inside and out, 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 perforated solid steel liner.

**2.3**

**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.

**2.4**

**FANS**

- .1 Cabinet hung, Free standing AMCA-rated for sound and performance centrifugal fans with backward inclined, forward curved 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 Motor: to ASHRAE 90.1.
- .2 Maximum sound power levels, as indicated.
- .3 Internally mounted motor and fan.

## 2.5 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 complete with seismic restraints: in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

## 2.6 FILTER BOX

- .1 Material to match casing. For flat and bag type filter arrangement.
  - .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) value 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.

## 2.7 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.

## 2.8 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.
    - .2 Blank-off plates. Insulated sandwich construction.
  - .2 Hot glycol coils: cleanable.

- .1 Tubes: copper.
- .2 Fins: aluminum, plate/spiral wound.
- .3 Headers: steel.
- .4 Pressure tests: 1.7 MPa.
- .3 Direct expansion refrigerant coils:
  - .1 Straight tube type arranged to prevent trapping of oil.
    - .1 Liquid distributors to ensure even distribution of liquid refrigerant to all circuits.
    - .2 Silver solder or braze joints in refrigerant tubing.
    - .3 Evacuate and charge coil with nitrogen and seal before sending to site.
  - .2 Tubes: copper.
  - .3 Fins: aluminum, plate/spiral wound.
  - .4 Headers: copper.
  - .5 Pressure tests: to Canadian Refrigeration Code. Dehydrated. Sealed with nitrogen charge.

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

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for self-contained multizone and single zone, gas, electric, and refrigeration packaged HVAC units.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)
  - .1 ANSI/ARI 210/240-03, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .2 ARI 270-95, Sound Rating of Outdoor Unitary Equipment.
- .2 ANSI/UL 1995 B-1998, Standard for Heating and Cooling Equipment.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B52-99, Mechanical Refrigeration Code.
  - .2 CSA C22.1 HB-02, Canadian Electrical Code Handbook.
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association
  - .1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for packaged HVAC units.
- .3 Shop Drawings:
  - .1 Submit shop drawings to indicate project layout and dimensions; indicate:
    - .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
    - .2 Piping, valves, fitting shipped loose showing final location in assembly.
    - .3 Control equipment shipped loose, showing final location in assembly.

- .4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
  - .5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.
  - .6 Fan performance curves.
  - .7 Details of vibration isolation.
  - .8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
  - .9 Type of refrigerant used.
- .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: 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 include data as follows:
    - .1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.
    - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
  - .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ - 4.1 Low-Emitting Materials: Adhesives and Sealants.
    - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
  - .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ - 4.2: Low-Emitting Materials: Paints and Coatings.
    - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.

- .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
- .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## 1.5 WARRANTY

- .1 For Work of this Section 23 74 00 Packaged Outdoor HVAC Equipment, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 24 months.
- .2 Contractor hereby warrants that packaged rooftop HVAC units and refrigeration compressors will function and operate in accordance with CCDC 2 GC 24, but for 24 months.

## Part 2 Products

### 2.1 GENERAL

- .1 Outdoor, self-contained multizone unit with gas burner hot glycol coil and DX refrigeration and bear label of CSA, CGA, FM, and ULC.
- .2 Units to consist of cabinet and frame, supply fan, return fan heat exchanger, burner with heater control, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper, return damper, motorized gravity exhaust damper.
- .3 Conform to ANSI/ARI 210/240, rating for unit larger than 40 kW nominal.

### 2.2 CABINET

- .1 Cabinets: weatherproofing tested and certified to AGA rain test standards and soundproofing tested to ARI 270, dbA at 1 m free field.
- .2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs.
- .3 Outer casing: weathertight 1.2 mm thick galvanized steel with baked enamel finish, complete with flashing.
- .4 Access: removable gasketed hinged doors or panels with quick locking door handle type screwdriver operated flush cam type fasteners.
- .5 Insulation: neoprene coated glass fiber on surfaces where conditioned air is handled, 50 mm thick, 32 kg/m<sup>3</sup> density.

### 2.3 FANS

- .1 Centrifugal, forward curved impellers, statically and dynamically balanced. Multi V-belt drive with adjustable variable pitch motor pulley, rubber/spring isolated hinge mounted



motor fan and motor integrally mounted on isolation base, separated from unit casing with flexible connections and spring isolators . Vibration isolators: 95 % efficiency.

## **2.4 AIR FILTERS (2 Stages)**

- .1 50 mm thick, 30% efficiency, metal framed throwaway, standard to unit manufacturer and MERV 13 bag filters.
- .2 To meet NFPA 90A, air filter requirements type Class 1 type Class 2.

## **2.5 HEAT EXCHANGERS AND BURNERS**

- .1 Gas fired, multiple flue passes, with primary heating surface of aluminized type or stainless steel; secondary heating surface, stainless steel/aluminized tubes.
  - .1 Gas burner: factory mounted, wired and fire tested complete with operating and safety controls.
  - .2 Forced/Induced draft continuous port steel multi-slotted non-clogging cast iron inshot type.
  - .3 Spark ignited pilot with pilot flame safety shut-off.

## **2.6 HOT GLYCOL COIL**

- .1 Aluminum fins, mechanically bonded to copper tubes.
- .2 Piping: complete with shut off valves, drain valves, unions or flanges.
- .3 Hydrostatically tested to 1.7 MPa.

## **2.7 REFRIGERATION**

- .1 Conform to CSA B52 and ANSI/UL 1995 requirements.
- .2 Compressor/Condenser Section:
  - .1 Semi-Hermetic/Hermetic compressors, vibration isolated with flexible suction and discharge connections, oil sight glass, oil pressure switch, crankcase heater, and automatic pump down system with control to liquid line solenoid valve.
  - .2 Fans: propeller type with single piece spun venturi outlets and zinc plated guards. Motors: sequenced for head pressure control.
  - .3 Electrical system: complete with operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof, rain tight disconnect.
  - .4 Include refrigerant piping with automatic hot gas bypass , sight glass, filter and valves.
  - .5 Condenser: staggered copper tube aluminum fin coil assembly with sub-cooling rows to provide 5 degrees C sub-cooling.
  - .6 Capacity reduction: hot gas bypass or cylinder unloading. Hot gas side port distribution . Provide fan control/flooding for head control for low ambient operation down to 10 degrees C ambient temperature.

- .7 Refrigerant: R 410A/R 407C.
- .3 Evaporator:
  - .1 Rated to ANSI/ARI 210/240.
  - .2 Thermostatic expansion valve, with adjustable super heat and external equalizer.
  - .3 Coil: NPS 1/2/NPS 5/8 od staggered seamless copper tubes expanded into aluminum fins, and insulated condensation pan.
  - .4 Cooling coil condensate drain pans: designed to avoid standing water, easily cleaned or removable for cleaning. Drain connection: deep seal trap complete with trap seal primer.

## 2.8 CONTROLS

- .1 In addition to combustion safety controls, provide low limit on supply and freeze protection on glycol coils.
- .2 Single Zone Cooling Control:
  - .1 Zone sensor/Room thermostat to activate cooling relay in control circuit cycling compressor. Provide safeties and pressure controls. Condenser fans to operate in sequence.
  - .2 As back pressure is reduced, hot gas bypass opens to maintain set back pressure.
  - .3 When call for cooling is satisfied, relay is de-energized closing liquid line solenoid valve and pumps down. On two compressor units provide separate circuits to evaporator and condenser and manual double pole double throw switch for lead-lag unit choice.
- .3 Mixed Air Single Zone Unit:
  - .1 Automatic outside and return air dampers for fixed outside air quantity.
  - .2 Remote controlled outside and return air dampers with damper operator and remote rheostat package for adjusting outside air quantity.
  - .3 Motorized outside, return and automatic gravity relief dampers with spring return damper operator and control package to automatically vary outside air quantity. Outside air and exhaust air dampers, normally closed.
  - .4 Tight fitting opposed blade dampers with neoprene or suitable gaskets, bronze bushings and 1% maximum leakage.
  - .5 Damper operation: 24V, spring return motor with gear train sealed in oil, and heater for operation under minus 18 degrees C.
  - .6 Mixed air controls: maintain indicated mixed air temperature, lock out compressor below 14 degrees C ambient, restart 17 degrees C, revert dampers to provide 10% fresh air above 21 degrees C adjustable.

- .4 Single Zone Heat-Cool Unit:
  - .1 Low voltage, adjustable room thermostat controls burner operation, heater stages in sequence with delay between stages, compressor and supply fan to maintain room temperature setting.
  - .2 Thermostat: include system selector switch day-night heat-cool-off and fan control switch (on-auto).
  - .3 Automatic changeover thermostat: with stage heating and stage cooling. Electronic programmable with battery back up.
  - .4 Provide remote mounted fan control switch on remote panel.
- .5 Night mode: unit cycles as unit heater with 100% recirculation on winter or summer cycles unit off.

## **2.9 REMOTE PANEL**

- .1 Provide remote readout panel for each unit containing:
  - .1 Signal lights indicating system status, heating system failure cooling system failure and dirty filters.
  - .2 Check switches proving signal light operation.
  - .3 System on-off switch cooling system on-off switch.
  - .4 Fan on-off switch.
  - .5 Manual 6 12 h timer to override night-set back control remote damper control on outside air damper.
- .2 Provide gauges in remote panel indicating outside air, mixed air, return air and discharge air temperatures for each deck before heat exchangers.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install as per manufacturers' instructions as indicated.
- .2 Manufacturer to certify installation, supervise start-up and commission unit.
- .3 Run drain line from cooling coil condensate drain pan to discharge over nearest roof drain.

### 3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, and protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
  - .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 at stages listed:
    - .1 After delivery and storage of products, and when preparatory work on which 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 work, after cleaning is carried out.
  - .2 Obtain reports within 3 days of review and submit immediately to Contract Administrator.
  - .3 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
  - .4 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.
  - .5 Performance Verification:
    - .1 Outdoor Air Handling Units:
      - .1 Set zone mixing dampers for full cooling, except that where diversity factor forms part of design set that % of zone dampers to full heating.
      - .2 Set outside air and return air dampers for minimum outside air.
      - .3 Set face and bypass dampers so face dampers are fully open and bypass dampers are fully closed.
      - .4 Check for smooth, vibration less correct rotation of supply fan impeller.
      - .5 Measure supply fan capacity.
      - .6 Adjust impeller speed as necessary and repeat measurement of fan capacity.
      - .7 Measure pressure drop each component of air handling unit.
      - .8 Set outside air and return air dampers for the % of outside air required by design and repeat measurements of fan capacity.
      - .9 Reduce differences between fan capacity at minimum and maximum outside air less than 5 %.
      - .10 Set face and bypass dampers to full bypass and repeat measurement of fan capacity.
      - .11 Reduce difference between fan capacity with F&BPD fully closed to bypass and fully open to bypass to less than 5 %.

- .12 Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5 %.
  - .13 OAD: verify for proper stroking, interlock with RAD.
  - .14 Measure DBT, WBT of SA, RA, EA.
  - .15 Measure air cooled condenser discharge DBT.
  - .16 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.
  - .17 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.
  - .18 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake or to condenser intake.
  - .19 Simulate maximum heating load and:
    - .1 Verify temperature rise across heat exchanger.
    - .2 Perform flue gas analysis. Adjust for peak efficiency.
    - .3 Verify combustion air flow to heat exchanger.
    - .4 Simulate minimum heating load and repeat measurements.
  - .20 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.
  - .21 Verify operating control strategies, including:
    - .1 Heat exchanger operating and high limit.
    - .2 Early morning warm-up cycle.
    - .3 Freeze protection.
    - .4 Economizer cycle operation, temperature of change-over.
    - .5 Alarms.
    - .6 Voltage drop across thermostat wiring.
    - .7 Operation of remote panel including pilot lights, failure modes.
  - .22 Set zone mixing dampers for full heating and repeat measurements.
  - .23 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5 %.
  - .24 Measure return fan capacity.
  - .25 Adjust impeller speed as necessary and repeat measurement of return fan capacity.
  - .26 Check capacity of heating unit.
  - .27 Measure DX refrigeration system performance as specified Section .
  - .28 Refer to other sections of these specifications for PV procedures for other components.
- .2 Start-Up:
  - .3 Verify accessibility, serviceability of components including motorized dampers, filters, coils, fans, motors, operators, sensors, electrical disconnects.
  - .4 Verify accessibility, clean ability, and drainage of drain pans for coils.

.6 Commissioning Reports:

- .1 In accordance with Section 01 91 00 – LEED Commissioning. Include:
  - .1 Report forms as specified Section 01 91 00 – LEED Commissioning.

**3.4 DEMONSTRATION**

- .1 Training: in accordance with Section 01 91 00 – LEED Commissioning.

**3.5 CLEANING**

- .1 Perform cleaning operations as specified in accordance with manufacturer's recommendations.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include:
  - .1 Replacement data for motor element, thermostat and switch.
  - .2 Mounting methods.
  - .3 kW rating, voltage, phase.
  - .4 Cabinet material thicknesses.
  - .5 Physical size.
  - .6 Finish.
  - .7 Thermostat, transformer, controls where integral.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
- .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
  - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
- .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
  - .1 Conform with VOC and Chemical component limits of Green Seal’s Standard GS-11 January 1993 requirements.
  - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
  - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

**Part 2 Products**

**2.1 FORCED AIR HEATERS**

- .1 Forced airheaters, wall mounted commercial type as follows:
  - .1 Enclosure:
    - .1 18 gauge steel.
    - .2 Knockouts for 12 mm diameter conduit left, right, bottom and rear.

- .3 Grill and frame finished white.
- .2 Elements and Fan:
  - .1 Motor: totally enclosed, shaded pole, impedance protected motor.
- .2 Controls:
  - .1 Built-in tamperproof controls. 'On-Off-Fan Only' selector switch and temperature control knob.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install heaters in accordance with manufacturer's instructions.
- .2 Make power and control connections.

**3.2 FIELD QUALITY CONTROL**

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

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCES**

- .1      Canadian Standards Association (CSA International)
  - .1          CSA C22.2 No.46-M1988, Electric Air-Heaters.
- .2      Underwriters' Laboratories (UL) Inc.
  - .1          UL 1042-1994, Electric Baseboard Heating Equipment.

**1.2                PRODUCT DATA**

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

**1.3                CLOSEOUT SUBMITTALS**

- .1      Submit operation and maintenance data for baseboard convectors in accordance with Section 01 78 00 - Submittal Procedures.

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1      Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2      Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
- .3      Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
  - .1          Low VOC complying with SCAQMD Rule #1168, October 2003,
- .4      Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.

- .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
- .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
- .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2            Products**

### **2.1                MANUFACTURERS**

- .1 Acceptable manufacturers:
  - .1 Chromalux.
  - .2 Ouellet.
  - .3 Qmark.
  - .4 Stelpro.

### **2.2                BASEBOARD CONVECTORS**

- .1 Heaters: to CSA C22.2 No.46 UL 1042, standard wattage density with connection box both ends.
  - .1 Element through-type fitted with aluminum convector vanes.
- .2 Cabinet: 22 gauge thick finished in epoxy / polyester powder paint, colour white.
- .3 Approved wiring channel for interconnection of heaters and components.
- .4 Knock-outs for 12 mm dia. conduit connection.
- .5 Additional accessories as indicated:
  - .1 Relay section.
  - .2 Duplex outlet section.
  - .3 Air conditioning switch section.
  - .4 Inside and outside corners.
  - .5 Splice plates.

### **2.3                CONTROLS**

- .1 Wall mounted thermostats: type line voltage.
- .2 Integral thermostats: 2 pole to control load as indicated.

## **Part 3            Execution**

### **3.1                INSTALLATION**

- .1 Attach baseboard heaters to wall.

- .2      Install thermostats in locations indicated.
- .3      Make power and control connections.

**3.2                      FIELD QUALITY CONTROL**

- .1      Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2      Ensure that heaters and controls operate correctly.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

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

**1.2                PRODUCT DATA**

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

**1.3                CLOSEOUT SUBMITTALS**

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

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1        Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2        Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.
- .3        Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
  - .1            Low VOC complying with SCAQMD Rule #1168, October 2003,

- .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
  - .1 Conform with VOC and Chemical component limits of Green Seal’s Standard GS-11 January 1993 requirements.
  - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
  - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable manufacturers:
  - .1 Chromalox.
  - .2 Ouellet.
  - .3 Qmark.
  - .4 Stelpro.

### **2.2 UNIT HEATERS**

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection.
- .3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.
  - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: as indicated.
- .5 Elements: stainless steel tubular heating elements.
- .6 Cabinet: 18 gauge steel, fitted with 360° brackets for wall or ceiling mounting.
  - .1 Epoxy / polyester power paint, almond colour.

### **2.3 CONTROLS**

- .1 Built in thermostat and support controls.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Suspend unit heaters from ceiling as indicated.
- .2 Make power and control connections.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

**END OF SECTION**

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**Part 1            General**

**1.1                SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for steam injection mechanical, atomizing, plenum mounted drum, plenum or duct mounted pad, packaged electrode steam generating, packaged, gas fired, steam generator type humidifiers and accessories.

**1.2                REFERENCES**

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

**1.3                SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures .
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for heating, ventilation and air conditioning distribution piping and ductwork.
- .3 Shop Drawings:
  - .1 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.
- .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.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Dispose of packaging and waste materials in appropriate on-site bins for recycling and disposal in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Indoor Environmental Quality Credit EQ - 4.4 Low - Emitting Materials. Co-ordinate with Section 01 35 21 - LEED Requirements.

- .3 Adhesives, sealants and sealant primers: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.1 Low-Emitting Materials: Adhesives and Sealants.
  - .1 Low VOC complying with SCAQMD Rule #1168, October 2003,
- .4 Paints and coatings: Low VOC to meet requirements of LEED Indoor Environmental Quality Credit EQ – 4.2: Low-Emitting Materials: Paints and Coatings.
  - .1 Conform with VOC and Chemical component limits of Green Seal's Standard GS-11 January 1993 requirements.
  - .2 VOC content of anti-corrosive coatings must be less than VOC content limits of Green Seal Standard GS-03 May 1997 requirements.
  - .3 Paints and coatings not covered by GS-11 and GS-03 to meet requirements of SCAQMD Rule #1113, November 1996.

## 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, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.

## Part 2 Products

### 2.1 DIRECT STEAM INJECTION TYPE

- .1 Direct steam injection type humidifiers to include:
  - .1 Stainless steel jacketed duct distribution manifolds. Number to suit duct shape and size.
  - .2 Steam separator with baffle.
- .2 Steam control valve with electric actuator, field or factory installed for modulating control.
- .3 Steam trap assembly: as recommended by manufacturer.
- .4 Capacity:
  - .1 As indicated.
- .5 Controls: as required.

### 2.2 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 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.

### **Part 3 Execution**

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

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

#### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturers instructions.
- .2 Humidifier and evaporator media to be new and clean when project is accepted.
- .3 Install humidistat in accessible location.
- .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 Contract Administrator.
- .2 Performance Verification (PV):
  - .1 General: in accordance with Section 01 91 00 – LEED Commissioning.
  - .2 Application tolerances: as indicated.
  - .3 Timing:
    - .1 After TAB of ducted air systems.
    - .2 At same time as PV of related air handling units.
  - .4 PV procedures:
    - .1 Direct Steam Injection Humidifiers: .
    - .2 Packaged Electrode Steam Generating type: .
- .3 Start-up:
  - .1 General: in accordance with Section 01 91 00 – LEED Commissioning.
  - .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.
- .4 Commissioning Reports:
  - .1 General: in accordance with Section 01 91 00 – LEED Commissioning. Include:
    - .1 PV results on approved PV Report Forms.
    - .2 Product Information Report Forms.

### 3.4 DEMONSTRATION

- .1 Training: in accordance with Section 01 91 00 – LEED Commissioning.

**3.5 CLEANING**

- .1 Perform cleaning operations as specified and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**