

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 21 05 01 - Mechanical General Requirements.

1.2 References

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 National Plumbing Code of Canada - 2010.
- .3 National Building Code of Canada - 2010.

1.3 Scope of Work

- .1 This section applies to installation of piping for each of the following systems:
 - .1 Condensate drain lines.
 - .2 Hot Water Heating Supply and Return lines.
 - .3 Fuel supply and return lines.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 Connections to Equipment

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

3.2 Clearances

- .1 Provide clearance around systems, equipment, and components for observation of operation, inspection, servicing, maintenance, and as recommended by manufacturer.

- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 Drains

- .1 Install drain valve at low points in piping systems, at equipment and so that each section of piping can be drained.
- .2 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .3 Drain valves: 19mm ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 Air Vents

- .1 Install automatic air vents at high points in piping systems. Locations shall be indicated on the "Record" drawings.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.5 Di-electric Couplings

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 50mm and under: Isolating unions or bronze valves.

3.6 Pipework Installation

- .1 Screwed fittings to be jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Install piping, equipment, and similar items parallel or perpendicular to building lines.

- .6 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.
- .7 Except where indicated, install so as to permit separate thermal insulation of each pipe.
- .8 Group piping wherever possible (and as indicated).
- .9 Ream pipes, remove scale and other foreign material before assembly.
- .10 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .11 Install copper pipe/tube so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
- .12 Clean all excess flux and solder from joints.

3.7 Valves

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above the horizontal position unless otherwise indicated.
- .4 Valves to be accessible for maintenance without removing adjacent piping.

3.8 Sleeves

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Where sleeves extend above finished floors - to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6.4mm minimum clearance all round 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 25mm 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 Provide space for firestopping. Maintain fire rating integrity.
 - .2 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .3 Ensure no contact between copper pipe or tube and sleeve.

3.9 Escutcheons

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

3.10 Preparation for Firestopping

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation.
- .2 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.11 Pressure Testing of Equipment and Pipework

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

3.12 Existing Systems

- .1 Connect into existing piping systems at times approved by the Owner's representative.
- .2 Request written approval ten (10) days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 21 13 13 - Wet Pipe Sprinkler System.
- .2 Section 23 05 05 - Installation of Pipework.
- .3 Section 23 31 13 - Ductwork - Low Pressure Metallic to 500 Pa.
- .4 Section 21 05 01 - Mechanical General Requirements.

1.2 References

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME):
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
 - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP-69, Pipe Hangers and Supports - Erection and Application.
 - .3 MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation.

1.3 Design Requirements

- .1 Construct pipe hanger and support utilizing manufacturer's regular production components, parts and assemblies.
- .2 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

PART 2 - PRODUCTS

2.1 General

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58.
- .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 used outside the building: galvanized after manufacture with hot dipped galvanizing process.
 - .2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
 - .3 Apply to hangers, supports and equipment fabricated from ferrous metals at least one (1) coat of corrosion resistant paint before shipment to job site. Touch-up damaged finish surfaces to satisfaction of Engineer.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.
 - .1 Cold piping 50mm maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut.
 - .1 Rod: 13mm FM approved
 - .2 Acceptable Products: Myatt Fig. 586; Grinnell Fig. 131, Hunt, Cooper B-Line, Mason Industries.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
 - .1 Cold piping 50mm maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS-SP-69.
 - .1 Acceptable Products: Myatt; Grinnell Fig. 62, Anvil, Taylor, Hunt, Cooper B-Line, Mason Industries.
- .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 6.4mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate ULC listed to MSS-SP-69.
- .5 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.

- .3 Use 22mm hanger rod for 150mm piping, 16mm hanger rod for 100mm piping, and 9.5mm hanger rod for smaller piping.
- .6 Pipe attachments: material to MSS SP-58.
 - .1 Attachments for steel piping: carbon steel black.
 - .1 Acceptable Products: Myatt Fig. 124; Grinnell Fig. 260, Anvil, Taylor, Hunt, Mason Industries.
 - .2 Attachments for copper piping: copper plated or epoxy coated black steel.
 - .1 Acceptable Products: Myatt Fig. 124; Grinnell Fig. 260, Anvil, Taylor, Hunt, Mason Industries.
 - .3 Attachments for cold water pipes: oversize to accommodate insulation thickness.
- .7 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A 563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper pipework: black, with formed portion plastic coated, epoxy coated.
- .8 Wall brackets: carbon steel prime coated; galvanized for exterior applications.
 - .1 Acceptable Products: Myatt Fig. 321; Grinnell Fig. 195, Anvil, Taylor, Hunt, Cooper B-Line, Mason Industries.

2.3 Riser Clamps

- .1 Steel pipe: black carbon steel to MSS-SP-58, type 42, ULC listed.
 - .1 Acceptable Products: Anvil Fig. 261, Cooper B-Line, Mason Industries.
- .2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42 or epoxy coated.
 - .1 Acceptable Products: Anvil Fig. CT-121, Cooper B-Line, Mason Industries.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.4 Variable Support Spring Hangers

- .1 Vertical movement: 13mm minimum, 50mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
 - .1 Acceptable Products: Anvil Fig. 98, Cooper B-Line.
- .3 Variable spring hanger to be complete with factory calibrated travel stops and spring scale plate.

- .4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.5 Equipment Supports

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

PART 3 - EXECUTION

3.1 Installation

- .1 Install in accordance with Manufacturer's instructions and recommendations.
- .2 All pipes shall be hung securely from structure.
- .3 Vibration Control Devices:
.1 Install on piping systems as indicated.
- .4 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 be to industry standards.
.3 Steel pipes: Install below coupling or shear lugs welded to pipe.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 Hanger Spacing

- .1 Hangers shall be spaced as far apart as economically possible. Maximum spacing shall be as follows:

Material/Service	Pipe Size (mm)	Maximum Spacing (mm)
Hard Temper Copper	Less than 32	2,135
	32 and Larger	3,050
Soft Temper Copper	All Sizes	2,440
Steel Water Pipe	25	2,135

Material/Service	Pipe Size (mm)	Maximum Spacing (mm)
	32 and over	3,050

- .2 Fire protection: to applicable fire code.
- .3 Fuel Oil Piping: Shall be in accordance with CSA B139-09, Installation Code for Oil-Burning Equipment.

3.3 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.

3.4 Horizontal Movement

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 100mm from vertical.
- .2 Where horizontal pipe movement is less than 13mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 Final Adjustment

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

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 21 13 13 - Wet Pipe Sprinkler System.
- .2 Section 21 05 01 - Mechanical General Requirements.

1.2 References

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .2 National Fire Protection Association:
 - .1 NFPA 13-2007, Installation of Sprinkler Systems.

PART 2 - PRODUCTS

2.1 Manufacturer's Equipment Nameplates

- .1 Metal nameplate with raised or recessed letters mechanically fastened to each piece of equipment by manufacturer.
- .2 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model, size, serial number, capacity, registration plates where specified or required (eg pressure vessel, ULC, CSA).
 - .2 Motor: voltage, Hz, phase, power, power factor, duty, frame size, rpm.

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 3.2mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	Sizes (mm)	No. of Lines	Height of Letters
1	9.5 x 50	1	3.2mm
2	13 x 75	1	6.4mm
3	13 x 75	2	3.2mm
4	19 x 100	1	8.5mm
5	19 x 100	2	6.4mm
6	19 x 200	1	8.5mm
7	25 x 125	1	13mm
8	25 x 125	2	8.5mm
9	38 x 200	1	19mm

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

.4 Locations:

.1 Equipment in Mechanical Rooms: Use size # 9.

2.3 Piping Systems Governed by Codes

.1 Identification:

.1 Sprinklers: To NFPA 13.

2.4 Identification of Piping Systems

.1 Identify contents by background colour marking, stencils, and/or pictogram (as necessary) showing name and service including temperature and pressure and directional flow arrows where relevant. To CAN/CGSB 24.3 except where specified otherwise.

.2 On P.V.C. jacket use the following material:

.1 Legend Markers, Arrows and Colour Bands: Pressure sensitive plastic coated cloth vinyl with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 149°C and intermittent temperature of 204°C. Apply to dry, clean prepared surfaces. Wrap 25mm colour band around pipe or pipe covering with ends overlapping one pipe diameter.

.2 Waterproof and Heat Resistant Pressure Sensitive Plastic Marker Tags: for pipes and tubing 19mm nominal and smaller.

.3 Acceptable Material: SMS Coilmark, W.H. Brady Inc., Seton Name Plate

Corp., and Top Tape and Label Ltd..

- .3 Stencilled Identification:
- .1 As an alternate to manufactured pipe markers identification may be stencilled on pipe except P.V.C. piping using a first quality oil base paint and colour bands. Letters shall be a minimum of 19mm high. Text to be black.
- .4 Identification of pipe to include Pictograms where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.
- .5 Use block capital letters 50mm high for pipes of 75mm nominal and larger o.d. including insulation and not less than 19mm high for smaller diameters.
- .6 Arrows showing direction of flow:
- .1 Outside diameter of pipe or insulation less than 75mm: 100mm long x 50mm high.
- .2 Outside diameter of pipe or insulation 75mm and greater: 150mm long x 50mm high.
- .3 Use double-headed arrows where flow is reversible.
- .7 Background colour marking to be full circumference of pipe or insulation, length to accommodate pictogram, full length of legend and arrows.
- .8 Colours and Legends:
- .1 Where not listed, obtain direction from Engineer.
- .2 Colours for legends, arrows: To following table:

Background Colour	Legend, Arrows
Yellow	BLACK
Green	WHITE
Red	WHITE

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

Contents	Background Colour Marking	Legend
Fuel Oil Supply	Green	FUEL OIL SUPPLY
Fuel Oil Return	Green	FUEL OIL RETURN
Hot Water Heating Supply	Yellow	HEATING SUPPLY
Hot Water Heating Return	Yellow	HEATING RETURN

Contents	Background Colour Marking	Legend
Condensate Drain Lines	Green	COND. DRAIN
Fire Protection Water	Red	FIRE

2.5 Identification Ductwork Systems

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

2.6 Valves, Controllers

- .1 Brass tags with 13mm stamped identification data filled with black paint.

2.7 Equipment

- .1 Identify Mechanical equipment with black lamicoid plates with white letters attached to equipment. Letters to be a minimum of 19mm high.
- .2 Identification to be visible by an individual standing on the floor.

2.8 Language

- .1 Identification to be in English.

PART 3 - EXECUTION

3.1 Installation

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC (and) (or) CSA registration plates as required by respective agency.
- .3 Identify all equipment, piping and duct systems.

3.2 Nameplates

- .1 Locate nameplates in conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Provide standoffs for nameplates on hot and/or insulated surfaces.

- .3 Do not paint, insulate or cover in any way.

3.3 Location of Identification on Piping and Ductwork Systems

- .1 On long straight runs in open areas in equipment rooms: At not more than 7.6m 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 room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 At beginning and end points of each run and at each piece of equipment in run.
- .6 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be 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.

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ASHRAE Standard 90.1 - latest edition.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449M, Standard Specification for Mineral Fibre-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .6 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.2, Thermal Insulation, Calcium Silicate, for Piping, Machinery and Boilers.
 - .2 CAN/CGSB-51.9, Mineral Fibre Thermal Insulation for Piping and Round Ducting.
 - .3 CAN/CGSB-51.11, Mineral Fibre Thermal Insulation Blanket.
 - .4 CAN/CGSB-51.12, Cement, Thermal Insulating and Finishing.
 - .5 CAN/CGSB-51.40, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
 - .6 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .7 CGSB 51-GP-53M, Jacketing, Polyvinyl, Chloride Sheet, for Insulating Pipes, Vessels and Round Ducts.
- .4 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .5 National Building Code of Canada - 2010.
- .6 National Plumbing Code of Canada - 2010.
- .7 National Energy Code of Canada for Buildings - 2011.

- .8 Manufacturer's Trade Associations:
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

1.2 Definitions

- .1 For purposes of this section:
 - .1 A/C - Air Conditioned Air
 - .2 E/A Exhaust Air "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible, chases and furred-in spaces.
 - .4 EXPOSED" - will mean "not concealed" as defined herein.
 - .5 O/A - Outside Air.
 - .6 R/A - Return Air.
 - .7 S/A - Supply Air.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 21 05 01 Mechanical General requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.4 Manufacturer's Instructions

- .1 Manufacturer's installation instructions to be submitted to the Engineer upon request.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.5 Qualifications

- .1 Installer to be specialist in performing work of this section, and have at least three years successful experience in this size and type of project.
- .2 Approved Contractors: Guilfords (2000) Inc., Scotia Insulations Ltd., Twin City Insulation, Zink's Mechanical Insulation, Pro-Insul Ltd., Parker Kaefer Inc..

1.6 Delivery, Storage and Handling

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

PART 2 - PRODUCTS

2.1 Fire and Smoke Rating

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

2.2 Insulation

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.
- .3 Rigid Duct Insulation:
 - .1 Rigid duct insulation will be, rigid fibre glass board, having a minimum density of 96 kg/m³.
 - .2 Rigid duct insulation vapour jacket will be factory applied foil-scrim-kraft facing consisting of aluminum foil reinforced with fibre glass yarn mesh and laminated to 2.7kg chemically treated fire resistant kraft.

2.3 Jackets

- .1 Canvas:
 - .1 8 oz. cotton, plain weave, treated with ULC listed dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: Compatible with insulation.

2.4 Accessories

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.

- .2 Acceptable Products Permastik 2001, Sealfast 30.36.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Acceptable Products Benjamin Foster 82-07 or Flintkote 230-04.
- .3 Tape: self-adhesive, aluminum, reinforced, 50mm wide minimum.
- .4 Contact adhesive: quick-setting.
- .5 Canvas adhesive: washable.
- .6 Galvanized wire, 15 gauge, annealed.
- .7 Galvanized mesh, hexagonal mesh, 15 gauge, galvanized annealed.
- .8 Fasteners: 4.1mm diameter pins with 38mm square clips, length to suit thickness of insulation.

2.5 Standard of Acceptance

- .1 Products of the following manufacturers are acceptable:
Bakor
Fibreglass Canada
Knauf Fibre Glass
Manson
Johns Manville

PART 3 - EXECUTION

3.1 Pre-installation Requirements

- .1 Pressure testing of ductwork systems to be complete.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 Installation

- .1 Apply materials in accordance with manufacturers instructions and this specification.
- .2 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.

- .3 Supports, Hangers in accordance with Section 23 05 29 Bases, Hangers and Supports
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .4 Install in accordance with TIAC National Standards.

3.3 Rigid Duct Installation

- .1 Rigid duct insulation with canvas covering and lagging will be used on exposed ducts.
- .2 Insulation will be applied with edges tightly butted and sealed with a 75mm wide strip of the vapour barrier material, applied with a compatible adhesive.
- .3 The insulation will be impaled on stick clips or pins welded to the duct, and secured with speed washers. Maximum spacing of pins will be 10 pin per square meter.
- .4 Penetrations of the vapour barrier will be patched with a strip of vapour barrier material.
- .5 Duct insulation and vapour barrier, where applicable, shall be continuous through walls and floor openings, except at fire dampers.
- .6 Where more than one thickness of insulation is required, stagger both longitudinal and horizontal joints.

3.4 Ductwork Insulation Schedule

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

Service	TIAC Code	Vapour Retarder	Insulation Thickness
E/A Ducts/Plenums	C-1	yes	50mm
O/A Ducts/Plenums	C-1	yes	50mm

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME-B16.3, Malleable-Iron Threaded Fittings.
 - .2 ASME-B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
 - .4 ASTM B75M, Standard Specification for Seamless Copper Tube.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-B139, Installation Code for Oil Burning Equipment.
 - .2 CSA-B140.0, Oil Burning Equipment: General Requirements.
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
 - .1 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.2 Submittals

- .1 Submittals in accordance with Section 21 05 01 - Mechanical General Requirements.
- .2 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 21 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 Fittings

- .1 Steel:
 - .1 Malleable iron: screwed, banded, Class 150 to ASME-B16.3.
 - .2 Welding: butt-welding to ASME-B16.9.
 - .3 Unions: malleable iron, brass to iron, ground seat, screwed, to ASTM A47/A47M.
 - .4 Nipples: Schedule 40, to ASTM A53/A53M.

2.2 Ball Valves

- .1 50mm and under:
 - .1 Bronze body, screwed ends, TFE seal, hard chrome ball, 4 MPa, WOG.

2.3 Automated Fuel Filtration System

- .1 The system shall be a stand alone, factory complete, automated programmable, fuel filtration system. The system shall be capable of eliminating microbial contamination and removing water, sediment, and particulate to comply with ASTM D975, Standard Specification for Diesel Fuel Oils.
- .2 All system components shall be contained in a powder coated, weatherproof, outdoor UL 50 listed enclosure with appropriate ventilation. Hinged front door shall be equipped with quarter turn key lockable handle. Drip tray with leak detection sensor shall be installed. Literature pocket and brackets for wall or rack mounting to be included. Note: The unit shall be mounted indoors as indicated on the plans.
- .3 The system shall be furnished with stainless steel shut-off valves on the inlet and outlet for easy filter/water separator maintenance. A see-through flow meter shall be installed to observe fuel flow and flow rate. Above mentioned components shall be located within the enclosure; all internal piping shall be stainless steel.
- .4 The system shall consist of a 4-stage filtration/water separation process:
 - .1 Stage 1: Centrifugal water and particulate separation.
 - .2 Stage 2: Coalescing water (99.9% water removal) and 30 micron particulate filter element - with water detection sensor and “push and turn” safety drain valve.
 - .3 Stage 3: Fuel Conditioner - to break down sediments and solids naturally forming in diesel fuel to submicron levels, as well as, preventing microbial contamination eliminating the need for toxic chemical biocides.
 - .4 Stage 4: Secondary 3 micron particulate and water absorbing spin-on filter. Primary and secondary filters shall be equipped with liquid filled, stainless steel gauges.
- .5 The system control features, indicator lights, and emergency stop button shall be located on a descriptive external control panel on the front door of the enclosure. Additional alarm and system status information shall be displayed on a dedicated webpage that monitors the system, as well as, delivered through email and SMS messages to designated individuals. System shall provide the following display functions:
 - .1 Full Modbus TCP/IP and LAN connectivity.

- .2 Programmable digital timer - memory backup to retain program memory during power outages.
 - .3 Pump operating hour counter.
 - .4 Pump control switch (Auto-Off-Manual).
 - .5 Alarm reset - external access.
 - .6 Power available indicator, green indicator, external display.
 - .7 Pump running indicator, amber indicator, external display.
 - .8 High vacuum, high pressure, no flow, high water alarm and leak detection, red indicator, external display.
 - .9 Emergency stop pushbutton, red, latching, external access.
- .6 All electrical control features shall be contained within a separate UL 508A listed industrial control panel located within the mechanical enclosure. The controller shall monitor the following system alarm points:
- .1 Leak in enclosure detection (system shutdown);
 - .2 Primary filter high vacuum sensor (system shutdown);
 - .3 Primary filter high water sensor (system shutdown);
 - .4 Secondary filter high pressure sensor (system shutdown);
 - .5 Flow switch (system shutdown after priming delay);
 - .6 External system shutdown input.
- .7 The pump shall be a positive displacement, internal gear, direct-coupled, rotary pump with cast iron housing and built-in pressure relief bypass valve. Pump flow rate shall be 4 gallons per minute (15.1 LPM).
- .8 The motor shall be UL listed, TEFC complete with thermal overload protection. Electrical requirements as indicated on the plans.
- .9 The system shall be capable to turn the complete tank volume over once per month with a required runtime of no more than 48 hours for the total volume. Sufficient contaminant and water holding capacity should be ensured. System runtime shall be adjusted in accordance with the input from pressure and vacuum gauges, as well as, water sensor.
- .10 The system shall provide dry contacts for summary alarm and leak detection to interface with the building automation system. An external shutdown feature shall be provided to disable or control pump operation from a remote point.
- .11 Acceptable Products: Algae-X International.

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 Piping

- .1 Install piping in accordance with Section 23 05 01 - Installation of Pipework, supplemented as specified.
- .2 Install oil piping system in accordance with CSA -B139 and CSA-B140.0.
- .3 Slope piping down in direction of day tank unless otherwise indicated.
- .4 Suction and return piping inside building:
 - .1 Generator Equipment Room: steel, with screwed fittings.

3.3 Valves

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

3.4 Automated Fuel Filtration System

- .1 Install the system as per the manufacturer's requirements. Wiring for the system shall be provided by the electrical contractor.

3.5 Cleaning

- .1 Flush after pressure test with number 2 fuel oil for a minimum of two hours. Clean strainers and filters.
 - .1 Dispose of fuel oil used for flushing out in accordance with requirements of authority having jurisdiction.
 - .2 Check vents from regulators, control valves are terminated in approved location and are protected against blockage and damage.
 - .3 Check entire installation is approved by authority having jurisdiction.
 - .4 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 Related Sections

- .1 Section 21 05 01 - Mechanical General Requirements.

1.2 References

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ANSI/ASME, Boiler and Pressure Vessels Code (BPVC).
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A 47/A47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 345°C.
 - .3 ASTM A 516/A516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A 536, Specification for Ductile Iron Castings.
 - .5 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA):
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 21 05 01 - Mechanical General Requirements.

1.4 Closeout Submittals

- .1 Submit maintenance data in accordance with Section 21 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 Automatic Air Vents

- .1 Industrial float vent: cast iron body and 13mm connection and rated at 862 kPa working pressure.
- .2 Float: solid material suitable for 116°C working temperature.
- .3 Acceptable Materials: Amtrol; Armstrong; Braukmann; Maid-O-Mist No. 7; Taco, Flo Fab.

PART 3 - EXECUTION

3.1 General

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines and blow off connections to terminate above nearest floor drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- .5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 Air Vents

- .1 Install at high points of systems.
- .2 Install mini ball valve on automatic air vent inlet. Run discharge to nearest floor drain.
- .3 Arrange piping so that air purging will follow in the direction of water flow in both branches and risers.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 23 05 05 - Installation of Pipework.
- .2 Section 21 05 01 - Mechanical General Requirements.

1.2 References

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):
 - .1 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings, (Class 25, 125 and 250).
 - .2 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, (Classes 150 and 300).
 - .3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .4 ANSI/ASME B16.9, Factory-Made Wrought Butt welding Fittings.
 - .5 ANSI/ASME B18.2.1, Square and Hex Bolts and Screws.
 - .6 ANSI/ASME B18.2.2, Square and Hex Nuts.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A 47/A47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A 536, Specification for Ductile Iron Castings.
 - .4 ASTM B 61, Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA):
 - .1 CSA B242-11, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
- .4 Manufacturer's Standardization of the Valve and Fittings Industry (MSS):
 - .1 MSS-SP-70-11, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS-SP-71-11, Cast Iron Swing Check Valves Flanged and Threaded Ends.
 - .3 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
 - .4 MSS-SP-85-11, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 21 05 01 - Mechanical General Requirements.

1.4 Closeout Submittals

- .1 Provide maintenance data for incorporation into manual specified in Section 21 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 Pipe

- .1 Steel pipe: to ASTM A53, Grade B, as follows:
 - .1 50mm and smaller, Schedule 40.

2.2 Pipe Joints

- .1 Less than 50mm: Screwed fittings with Teflon tape or pulverized lead paste.
- .2 Pipe thread: taper.

2.3 Fittings

- .1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
- .2 Unions: malleable iron, to ASTM A 47/A47M and ANSI/ASME B16.3.

2.4 Valves

- .1 Connections:
 - .1 Under 50mm: Screwed ends.
- .2 Globe valves: Application: Throttling, flow control, emergency bypass:
 - .1 50mm and under:
 - .1 103 kPa and under: Class 125, rising stem, PTFE disc, bronze stem and seat.
 - .2 Acceptable Product: Crane Fig.5TF, Kitz #03.
- .3 Ball Valves: Isolating equipment, control valves, pipelines:
 - .1 50mm and under:
 - .1 4,135 kPa WOG, full port, forged brass, two piece body, PTFE seats and packing stem.
 - .2 Acceptable Product: Crane Fig 9202, Kitz #58.
- .4 Drain valves:
 - .1 On radiation: Solid forged brass construction, solid brass body, forged brass cap, brass chain and hook, composition disc suitable for 249°C, working

pressure 1,379 kPa at 249°C.

- .1 Acceptable Product: Dahl #21.616.
- .5 Balancing, for TAB:
 - .1 Sizes: Calibrated balancing valves for flow measurement, balancing and drip tight shut off.
 - .2 50mm and under:
 - .1 Bronze, equal percentage globe style, multi turn(minimum four full turns) adjustment with micrometer type indicator, memory stops, two 6.4mm metering ports with checks and gasketed caps, two 6.4mm connections with brass plugs for alternate metering location.
 - .3 Acceptable Products: Armstrong, Taco, Bell & Gossett, Tour&Anderson 787, 788, 789.

PART 3 - EXECUTION

3.1 Piping Installation

- .1 In accordance with Section 23 05 05 - Installation of Pipe Work.

3.2 Circuit Balancing Valves

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

3.3 Testing

- .1 Test system in accordance with Section 21 05 01 - Mechanical General Requirements.

3.4 Balancing

- .1 Balance water systems to within plus or minus 5% of design output.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 21 05 01 - Mechanical General Requirements.

1.2 References

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A 480/A480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A635M, Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A 653/A653M, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .2 National Fire Protection Agency (NFPA):
 - .1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
 - .3 NFPA 91, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Non-combustible Particle Solids.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
 - .2 SMACNA HVAC Duct Leakage Test Manual.

1.3 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 21 05 01-Mechanical General Requirements.
- .2 Indicate following:
 - .1 Sealants.
 - .2 Tape.
 - .3 Proprietary Joints.

1.4 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.

PART 2 - PRODUCTS

2.1 Seal Classification

- .1 Classification as follows:

Maximum Pressure	SMACNA Seal Class
500 Pa	C
250 Pa	C
125 Pa	C
<125 Pa	Unsealed
- .2 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with gaskets or sealant and tape. Longitudinal seams unsealed.

2.2 Sealant

- .1 Sealant: oil resistant, polymer type, water based, high pressure, non-toxic, flame resistant duct sealant. Temperature range of minus 29⁰C to plus 79⁰C.
 - .1 Acceptable Materials: Bakor Duct-Seal, Duro Dyne DSW, Ductmate PROseal, Foster.

2.3 Tape

- .1 Tape: polyvinyl treated, open weave fibreglass tape, 50mm wide.
 - .1 Acceptable Materials: Bakor 990-06, Duro Dyne FT-2.

2.4 Duct Leakage

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

2.5 Fittings

- .1 Fabrication: to SMACNA.
- .2 Transitions:
 - .1 Diverging: 20⁰ maximum included angle, unless indicated.
 - .2 Converging: 30⁰ maximum included angle, unless indicated.
- .3 Offsets:
 - .1 Full radiused elbows or as indicated.
- .4 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 Galvanized Steel

- .1 Lock forming quality: to ASTM A 653, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA HVAC duct construction standards.
- .3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered a Class A seal.
 - .1 Acceptable Materials: Ductmate Canada Ltd., Exanno Nexus.

2.7 Hangers and Supports

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm wide.
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods to the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
Up to 750	25 x 25 x 3.2	6.3
775 - 1050	32 x 32 x 3.2	6.3
1075 - 1500	38 x 38 x 3.2	9.5
1525 - 2075	50 x 50 x 3.2	9.5

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .1 Acceptable Materials: Myatt 492/494, Grinnell.
 - .2 For steel beams: manufactured beam clamps:
 - .1 Acceptable Materials: Myatt Fig. 586, Grinnell Fig. 86.

2.8 Sheet Metal Plenums

- .1 Nominal 18 ga. galvanized steel sheet re-squared and formed into 610mm wide panels with 50mm deep standing seams in accordance with SMACNA HVAC equipment and casings standard.
- .2 Formed channel sections top and bottom of vertical sections and at all wall and floor intersections.

- .3 Galvanized 50mm x 50mm x 3.2mm thick angle frames around all duct and access door openings.

2.9 Duct Joints

- .1 Ductwork is to be prefabricated using drive slip joints sized 450mm or greater. Joints 375mm or larger are to be reinforced.
- .2 Ductmate 25 and 35 and Nexus G and J shall be approved as an acceptable equal to the above requirements, with neoprene gaskets and HM572 sealant for bolted assembly.

PART 3 - EXECUTION

3.1 General

- .1 Do work in accordance with CSA B228.1 and SMACNA and as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .4 Clean all ductwork and plenums prior to system start-up. Submit report to Consultant for review.
- .5 Duct size 475mm wide and larger with more than 1 sq.m. or embraced panel shall be beaded or cross broken. This shall also apply to 20 gauge or less thickness and 750 Pa w.c. or less.
- .6 Ductwork at all intakes, all exhaust and other places where water from condensation may occur shall be watertight. At these places, ductwork shall be sloped towards a low point where a 32mm copper pipe connection for (i.e. tailpiece with trap) drainage purposes shall be installed.
- .7 Where ducts over 610mm wide are shown passing through masonry walls provide lintels and a continuous 32mm x 32mm x 6.4mm galvanized steel angle frame which shall be bolted to the construction and made air-tight to the same by applying caulking compound. Sheet metal at these locations shall be bolted to the angle iron.

3.2 Hangers

- .1 Strap hangers: install in accordance with SMACNA.

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

Duct Size	Spacing
to 1500mm	3050mm
1525mm and Over	2440mm

3.3 Watertight Duct

- .1 Provide watertight duct for:
 - .1 Outside air intake plenums.
 - .2 Exhaust air discharge plenums.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder, weld joints of bottom and side sheets. Seal other joints with duct sealer.
- .3 Install drains at base of risers, where noted on drawings, and other places where water may gather.

3.4 Sealing and Taping

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

3.5 Sheet Metal Plenums

- .1 Add sealant during closure of standing seams and channel sections and fasten with bolts or blind rivets at 305mm on centre.
- .2 Secure angle frames to wall or floor at 610mm on centre and caulk air-tight.
- .3 Provide light metal channel at wall and floor into which insulation can be finished.

3.6 Leakage Tests

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

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 21 05 01 - Mechanical General Requirements.

1.2 References

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

1.3 Product Data

- .1 Submit product data in accordance with Section 21 05 01 - Mechanical General Requirements.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.

1.4 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.

PART 2 - PRODUCTS

2.1 General

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards and CSA B228.1.

2.2 Flexible Connections

- .1 Frame: nominal 24 ga. galvanized sheet metal frame, minimum 75mm wide with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 4.4°C to plus 90°C, density of 3.2 kg/m².
- .3 Acceptable Products: Duro Dyne, Metal-Fab, Dyn-Air.

2.3 Access Doors in Plenums

- .1 Insulated: Sandwich construction of same material as plenum wall (nominal 22 ga.) Complete with 16 ga. Sheet metal angle frame and 50mm thick rigid glass fibre insulation.
- .2 Gaskets: Neoprene.
- .3 Hardware:
 - .1 Piano hinge and two “T” handle cam-locks operable from both sides, corrosion resistant materials.
 - .2 Hold open device.
 - .3 305mm x 305mm wired glass viewing panel.
 - .4 Minimum size: 915mm x 915mm.

PART 3 - EXECUTION

3.1 Installation

- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Connection to generator radiator.
 - .2 Length of connection: 100mm.
 - .3 Minimum distance between metal parts when system in operation: 50mm.
 - .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 305mm x 305mm for servicing entry.
 - .2 Locations:
 - .1 Motorized dampers.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 21 05 01 - Mechanical General Requirements.
- .2 Section 23 33 00 - Duct Accessories.

1.2 References

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A 653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 Shop Drawings

- .1 Submit product data in accordance with Section 21 05 01 - Mechanical General Requirements.
- .2 Indicate the following:
 - .1 Performance data.
 - .2 Dimensions, quantity.

1.4 Closeout Submittals

- .1 Provide maintenance data for incorporation into manual specified in Section 21 05 01 - Mechanical General Requirements.

1.5 Certification of Ratings

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

PART 2 - PRODUCTS

2.1 Multi-leaf Dampers

- .1 Opposed blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with internal polyurethane blade insulation, extruded EPDM elastomer seals, extruded thermoplastic frame seals, extruded aluminum frame complete with polystyrene insulation. Low leakage construction.

- .3 Bearings comprised of a celcon inner bearing fixed to a 11mm aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in the frame, no metal-to-metal or metal-to-plastic contact.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod. Linkage hardware is installed in frame side and constructed of aluminum and corrosion resistant zinc and nickel-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
- .5 Operator: as specified in the controls specification sections.
- .6 Performance: leakage in closed position to be less than 20 L/s/m² at 1000Pa w.c. differential across damper. Pressure drop at full open position for a 1220mm x 1220mm damper to be less than 75Pa w.c. differential across damper at 5.1m/s air flow.
- .7 Acceptable Materials: Tamco Series 9000 ECT (for intake and exhaust airstreams), Nailor Industries, Ruskin, Ventex.

PART 3 - EXECUTION

3.1 Installation

- .1 Opposed blade balancing dampers with locking quadrant shall be provided.
- .2 Install insulated dampers at fresh air intakes and exhaust louvers.
- .3 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .4 Seal multiple damper modules with silicon sealant. Seal air tight between duct and damper frame for tight close-off.
- .5 Install access door adjacent to each damper, see Section 23 33 00 - Duct Accessories, so that each damper is observable, serviceable, and accessible.
- .6 Extend damper control rod or jackshaft through damper casing to the outside of the duct or equipment casing to allow proper connection of direct-coupled damper actuator.

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM E 90, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

1.2 Shop Drawings

- .1 Submit product data in accordance with Section 21 05 01 - Mechanical General Requirements.
- .2 Indicate the following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
 - .4 dimensions and weights.
 - .5 Installation directions.
 - .6 Finishes and materials of construction.

1.3 Test Reports

- .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

1.4 Certification of Ratings

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 Fixed Louvres - Aluminum

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500mm.
- .4 Frame, head, sill and jamb: 150mm deep one piece extruded aluminum, minimum

3 mm thick with approved caulking slot, integral to unit.

- .5 Mullions: at 1500mm maximum centres.
- .6 Fastenings: stainless steel (Society of Automotive Engineers) 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: 13mm exhaust, 13mm intake mesh, 2 mm diam wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: Fluoropolymar, Kynar or Durmar. Colour to be closely match existing stonework on building.
- .9 Louvres shall have extended sill frame.
- .10 Acceptable material: Penn Barry, Aerolite, Alumavent, Ruskin, McGill, Ventex, E.H. Price, Greenheck.

PART 3 - EXECUTION

3.1 Installation

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace for wind speed in accordance with NBC.
- .3 Anchor securely into opening. Seal with caulking all around to ensure weather tightness.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 Materials, accessories and installation for breechings, chimneys and stacks.

1.2 References

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- .2 Underwriters' Laboratories of Canada (ULC).
- .3 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 21 05 01 - Mechanical General Requirements. 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 21 05 01 - Mechanical General Requirements.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 21 05 01 - Mechanical General Requirements.
 - .2 Indicate following:
 - .1 Methods of sealing sections.
 - .2 Methods of expansion.
 - .3 Details of thimbles.
 - .4 Explosion (pressure) relief vent.
 - .5 Supports.
 - .6 Guy details.
 - .7 Rain caps.
 - .8 Bellow joints.
- .3 Closeout Submittals
 - .1 Submit operation and maintenance data for incorporation into manual specified in Section 21 05 01 - Mechanical General Requirements.

1.4 Quality Assurance

- .1 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.
- .2 Certificates:
 - .1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.5 Delivery, Storage and Handling

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

PART 2 - PRODUCTS

2.1 Diesel Generator Exhaust

- .1 Provide factory built exhaust system that is tested and listed by the Underwriter's Laboratories, Inc. For use with medium heat equipment which produce exhaust flue gas temperatures not exceeding 760°C under continuous operating conditions.
- .2 The double wall exhaust system shall have a 316 stainless steel inner liner and 304 stainless outer jacket. The fibre insulation between the inner and outer jacket shall be a nominal 50mm thick.
- .3 The exhaust system shall be designed and installed to be gas tight and thus prevent leakage of combustion products. The exhaust system shall be U.L. tested and listed to 15 kPa internal water column pressure.
- .4 Inner pipe joints shall be securely connected and sealed with factory supplied overlapping V-bands and appropriate sealant as specified in the manufacturer's installation instructions.
- .5 Connections to generator and expansion joints shall be made with matching flanges. Matching flanges shall be of the same size, bolt hole spacing and pressure rating as the flanges to which the connections are made.
- .6 The exhaust system shall be designed to compensate for all flue gas induced thermal expansion.

- .7 The exhaust system shall be complete with all required accessories including: lined bellows joints, 45 degree lateral tees, drain tee caps, 45 degree elbows, tapered increaser/reducer, angle rings, plate support assemblies, wall support assemblies, wall guide assemblies, flange adapters, flip top, explosion (pressure) relief valve, V-bands, and sealant.
- .8 Acceptable products: Selkirk Metalbestos, Metalfab, Security Chimney, Van Packer Co., Schebler.

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 Diesel Generator Exhaust

- .1 Inner pipe joints shall be sealed by use of factory supplied overlapping V-bands and sealant as specified in the manufacturer's installation instructions.
- .2 The exhaust piping and its supporting system shall resist side loads at least 1.5 times greater than the weight per foot of the piping for both horizontal and vertical portions.
- .3 The exhaust system shall be installed according to the manufacturer's installation instructions.
- .4 Provide all supports, guides, bellows type expansion joints, pressure relief valves, and flip top terminations as required to provide a complete system per the manufacturer's installation instructions.
- .5 The Mechanical Contractor shall confirm the exact chimney lengths on site prior to submitting shop drawings; coordinate measurements with the chimney manufacturer's representative.

END OF SECTION

PART 1 - GENERAL

1.1 Product Data

- .1 Submit product data in accordance with Section 21 05 01 - Mechanical General Requirements.
- .2 Submit product data sheets for unit heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
- .3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures and start-up procedure.

1.2 Shop Drawings

- .1 Submit shop drawings in accordance with Section 21 05 01 - Mechanical General Requirements.
- .2 Indicate:
 - .1 Equipment, capacity and piping connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.3 Closeout Submittals

- .1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 21 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 Horizontal Unit Heaters

- .1 Casing: 16 ga. thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.

- .2 Hot Water Coils: seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing. Hydrostatically test to 1034 kPa.
- .3 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.
- .4 Motor: speed as indicated continuous duty, built-in overload protection, and resilient motor supports.
- .5 Air outlet: four-way adjustable louvres.
- .6 Capacity as indicated.
- .7 Acceptable Products: Trane, Rosemex, Engineered Air, Sigma.

PART 3 - EXECUTION

3.1 Installation

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

END OF SECTION