

CFIA LAB DRYCOOLER
SPECIFICATIONS AND DRAWINGS

FOR MECHANICAL AND ELECTRICAL

1157 – 57 AVENUE N.E.
CALGARY, ALBERTA

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Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 00 50 – General Instructions.
- .2 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 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.
- .4 In addition to transmittal letter referred to in Section 01 00 50 – General Instructions use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Closeout / Substantial Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Division 01 requirements.
 - .2 Prior to requesting an inspection for **Substantial Performance**, provide a complete list of items which are deficient; certificate of Substantial Performance will not be granted unless the following items are completed:
 - .1 Heating, plumbing and fire protection systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation.
 - .2 Fire stopping for pipe are completed at all fire penetrations.
 - .3 Thermometers and pressure gauges in place and readable.
 - .4 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.
 - .5 Water systems have been balanced with draft report is submitted to Departmental Representative.

- .6 Painting, identification and valve tagging completed; touch up of equipment.
- .7 Letter of completion from the Control Sub-trade forwarded and all tests completed.
- .8 Systems have been chemically cleaned. Flush and initiate water treatment.
- .9 Provide report from manufacturer's representative to confirm status of treatment.
- .10 Draft Operating/Maintenance Manuals have been submitted.
- .11 Operating and Maintenance demonstrations have been provided to the Departmental Representative.
- .12 Written inspection report by manufacturer's representative has been submitted for noise and vibration control devices and flexible connections.
- .13 Warranty forms and letters forwarded and extended Warranty items identified.
- .14 Record drawings have been submitted.
- .15 All previously identified deficiencies have been corrected.
- .3 Prior to Total Performance Inspection provide declaration in writing that deficiencies noted at time of substantial performance inspection have been corrected and the following items completed prior to the total performance inspection:
 - .1 Submit final water balance reports.
 - .2 Submit final operating and maintenance manuals.
 - .3 Complete final calibration.
- .4 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .1 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.

- .2 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.
- .3 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.
- .4 Approvals:
 - .1 Submit one (1) copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .5 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .5 Site records:
 - .1 Departmental Representative will provide one (1) set of reproducible mechanical drawings. Provide sets of red 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 monthly to re-producibles, revising re-producibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.

- .6 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 1/2" high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .7 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 MAINTENANCE

- .1 Furnish spare parts in accordance with Division 01 requirements as follows:
 - .1 One (1) set of packing for each pump.
 - .2 One (1) set of belt for each belt driven equipments;
 - .3 One (1) casing joint gasket for each size pump.
 - .4 Two (2) head gasket set for each heat exchanger.
 - .5 Two (2) glass for each gauge glass.
 - .6 Valves:
 - .1 Washers- one (1) for each size valve and type.
 - .2 Seats- one (1) for each size valve and type.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01 requirements.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials in accordance with City of Calgary and CFIA requirements.

Part 2 Products - Not Applicable

Part 3 Execution

3.1 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.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

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

3.4 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

3.5 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 USE OF SYSTEM

- .1 Use of new permanent "Domestic Hot Water (DHW), Steam or Hot Water Heating" systems for supplying temporary DHW; humidification or building heating is permitted only under the following conditions:
 - .1 Entire system is complete, pressure tested, cleaned, flushed out.
 - .2 Specified water treatment system has been commissioned; water treatment is being continuously monitored.
 - .3 There is no possibility of damage from any cause.
 - .4 All systems will be:
 - .1 operated as per manufacturer's recommendations or instructions.
 - .2 operated by Contractor.
 - .3 monitored continuously by Contractor.
 - .5 Warranties and guarantees are not thereby relaxed.
 - .6 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
 - .7 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as-new" condition, filters in air systems replaced.

Part 2 Products - Not Applicable

Part 3 Execution - Not Applicable

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-1999, Ready-Mixed Organic Zinc-Rich Coating.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect, separate and place in designated containers for recycling Metal and Plastic in accordance with Waste Management Plan.
- .3 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products - Not Applicable

Part 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

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

3.2 CLEARANCES

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

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

- .1 Install automatic air vents at 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.

3.5 PIPEWORK INSTALLATION STEAM

- .1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.
- .2 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.
- .3 Install piping material specified as inside the building to 2500 mm outside of building.
- .4 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furring to a minimum.
- .5 Slope steam piping 0.5% in direction of flow and condensate return piping 0.7%. Provide drip trap assembly at all low points and in front of control valves. Run condensate lines from traps to nearest condensate receiver. Where condensate lines form a trap, provide vent loop over the trapped section.
- .6 Make reductions in steam pipes with eccentric reducing fittings installed to provide drainage and venting, bottom flat for steam.
- .7 Pipe the discharge from all relief valves, safety valves, vents, drains, equipment blow-downs, water columns and overflows to the nearest blow-down tank.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Uses of press fitting pipe system components are not acceptable on this project.
- .4 Uses of mechanical grooved couplings or fittings are not acceptable on this project.
- .5 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

- .6 Assemble piping using fittings manufactured to ANSI standards.
- .7 Steel Piping systems - Teeing off Main Line:
 - .1 Use reducing Tee (T), Sockolet (S) or Weldolet (W) type connection as per following schedule:

Branch (N.P.S)													
Header (NPS)		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10
	1/2	T											
	3/4	T	T										
	1	T	T	T									
	1 1/4	T	T	T	T								
	1 1/2	T	T	T	T	T							
	2	S	S	S	T	T	T						
	2 1/2	S	S	S	S	T	T	T					
	3	S	S	S	S	S	T	T	T				
	4	S	S	S	S	S	T	T	T	T			
	6	S	S	S	S	S	W	T	T	T	T		
	8	S	S	S	S	S	W	W	W	T	T	T	
	10	S	S	S	S	S	W	W	W	W	T	T	T

- .8 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .9 Install concealed pipe work to minimize furring space, maximize headroom, conserve space.
- .10 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .11 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .12 Group piping wherever possible or as indicated.
- .13 Ream pipes, remove scale and other foreign material before assembly.

- .14 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .15 Provide for thermal expansion as indicated.
- .16 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use gate or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Install 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.
 - .10 All equipment, gauges, sensors, strainers, filters, flow indicators, or in risers shall have isolation and if more than one inlet or outlet shall have a union for ease of maintenance.
- .17 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 1/4" minimum clearance between sleeve and un-insulated 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 125 mm above finished floor.
- .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

- .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
- .2 Elsewhere: Provide space for fire stopping. 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.

3.8 ESCUTCHEONS

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

3.9 PREPARATION FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 – Fire stopping.
- .2 Un-insulated unheated pipes not subject to movement: No special preparation.
- .3 Un-insulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging fire stopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

- .1 For the new pipes in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of existing of reused piping systems in accordance with requirements of Division 01 requirements.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative a minimum five (5) working days prior to performance of pressure tests.
- .2 Verify that:
 - .1 All valves are accessible.
 - .2 Instrument tapings are accessible, and adequate clearance has been provided to attach instruments.
 - .3 Major pieces of equipment are serviceable and connected to system with flanges or unions, etc.
 - .4 All pipe expansion has been allowed for.
- .3 Pipework: Test as follows:
 - .1 Heating water/glycol system: test to minimum of 1.5 times maximum working pressure or 1054 KPa water pressure at lowest point of system/section being tested.
 - .2 Domestic water system: test to minimum of 1.5 times maximum working pressure or 1054 KPa water pressure at lowest point of system/section being tested.
 - .3 Gas piping: test as required by authorities having jurisdiction.
 - .4 Sprinkler system: test as required by authorities having jurisdiction.
 - .5 Low pressure steam and condensate system: test to 860 KPa hydrostatic pressure.
- .4 Maintain specified test pressure without loss for twelve (12) hours minimum unless specified for longer period of time.
- .5 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Conduct tests in presence of Building Departmental Representative.
- .8 Pay costs for repairs or replacement, retesting, and making good to determine whether repair or replacement is appropriate.
- .9 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

- .10 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, and re-making joints in copper lines. Do not caulk.
- .11 For glycol systems, retest after cleaning. Repair leaking joints, fittings or valves.

3.12 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval **twenty-one (21) working 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.

3.13 PIPING SCHEDULE

System	Pipe	Fitting	Joint
Equipment drains and overflows	Copper water tube, type "K" Hard drawn	Wrought copper	Soldered, Lead-Free
Domestic water pipe above grade	Copper water tube, type "K" hard temper.	Wrought copper	Soldered, Lead-Free
DWV	DWV copper (above grade only)	Cast bronze	Soldered 50-50 tin-lead
		Wrought copper	Soldered 50-50 tin-lead
Hydronic Heating and 1035 KPa (Glycol Mix)	Black steel Schedule 40, 50 mm or less	Threaded	Screwed
		Welding	Welded
	Black steel Schedule 40, Greater than 50 mm	Welding	Welded
Low Pressure Steam (supply) up to 350 KPa	Black steel schedule 40	Welding	Welded

System	Pipe	Fitting	Joint
Steam Condensate (return) up to 175 KPa	Black steel schedule 80	Welding	Welded
Natural gas low pressure less than 175 KPa, inside building	Black steel, Schedule 40 50 mm or less	Threaded	Screwed
		Welding	Welded
	Black steel, Schedule 40 greater than 50 mm	Welding	Welded

END OF SECTION

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 Divisions 22, 23 and 25. 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 90.1-2006, 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 00 50 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 50 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .3 Quality Control: in accordance with Division 01 Requirements.
 - .1 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals
 - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Division 01 Requirements.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 GENERAL

- .1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1-2010.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 3/4 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 3/4 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees °C, 3 phase, 575 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

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

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

3.3 CLEANING

- .1 Proceed in accordance with Division 01 Requirements.
- .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 SECTION INCLUDES

- .1 Materials and installation for flexible connections, expansion joints, anchors and guides for building services piping.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A53/A53M-2002, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A105/A105M-2003, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 00 50 – General Instructions.
- .2 Submit product data and indicate for items as applicable:
 - .1 Manufacturer, model number, line contents, pressure and temperature rating.
 - .2 Movement handled, axial, lateral, angular and the amounts of each.
 - .3 Nominal size and dimensions including details of construction and assembly.
- .3 Submit maintenance data in accordance with Division 01 Requirements
 - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

Part 2 Products

2.1 SLIP TYPE EXPANSION JOINTS

- .1 Application: for axial pipe movement, as indicated.
- .2 Repacking: under full line pressure.
- .3 Body and packing housings: Class 150 carbon steel pipe to ASTM A53/A53M, Grade B. Wall thickness to match pipe with slip-on or weld neck flanges to match pipe.

- .4 Slip or traverse sleeves: carbon steel pipe to ASTM A53/A53M, Grade B, hard chrome plated.
- .5 Anchor base: construction steel, welded to body.
- .6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.
- .7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.
- .8 Packing rings: graphite impregnated non-asbestos.
- .9 Thermal plastic packing: graphite impregnated non-asbestos slug supplied loose.
- .10 Lubricating fittings: pet cocks with grease nipple.
- .11 Plunger body and plunger:
 - .1 Plunger body: heavy wall carbon steel welded to body.
 - .2 Plunger: carbon steel with hex head for use with socket wrench.
- .12 Lubricant: to manufacturer's recommendations.
- .13 Lubricant gun: complete with hose assembly.
- .14 Drip connection: 20 MPa forged steel to ASTM A105/A105M. Include half coupling with drain plug.

2.2 BELLOWS TYPE EXPANSION JOINTS

- .1 For axial, lateral or angular movements, as indicated.
- .2 Maximum operating pressure: 1054 KPa.
- .3 Maximum operating temperature: 120 degrees C.
- .4 Type A: free flexing, factory tested to 1 1/2 times maximum working pressure. Furnish test certificates.
- .5 Type B: externally pressurized, constant volume, pressure balanced, designed to eliminate pressure thrust, factory tested to 1 1/2 times maximum working pressure. Furnish test certificates.
- .6 Bellows:
 - .1 Multiple bellows, hydraulically formed, single ply, austenitic stainless steel for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.

- .7 Reinforcing or control rings:
 - .1 Two (2) piece nickel iron.
- .8 Ends:
 - .1 For butt welding weld neck flanges to match pipe.
- .9 Liner:
 - .1 Austenitic stainless steel in direction of flow.
- .10 Shroud:
 - .1 Carbon steel, painted.

2.3 FLEXIBLE CONNECTION

- .1 Application: to suit motion as indicated.
- .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
- .3 Inner hose: stainless steel corrugated.
- .4 Braided wire mesh stainless steel outer jacket.
- .5 Diameter and type of end connection: as per pipe size.
- .6 Operating conditions:
 - .1 Working pressure: 1054 KPa.
 - .2 Working temperature: 150 degrees C.
 - .3 To match system requirements.

2.4 ANCHORS AND GUIDES

- .1 Anchors:
 - .1 Provide as indicated or required.
- .2 Alignment guides:
 - .1 By conduit manufacturer.
 - .2 To accommodate specified thickness of insulation.
 - .3 Vapour barriers, jackets to remain uninterrupted.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide flexible pipe connectors on pipes connected to equipment supported by vibration isolation where indicated on the drawing.
- .2 Install expansion joints with cold setting, as indicated. Make record of cold settings.
- .3 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .4 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

3.2 CLEANING AND START-UP

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2001, Power Piping.
 - .2 ANSI/ASME Boiler and Pressure Vessel Code-2007:
 - .1 Section I: Power Boilers.
 - .2 Section V: Non-destructive Examination.
 - .3 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C206-1997, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
 - .1 AWS C1.1-2000, Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1-1999, Safety Welding, Cutting and Allied Process.
 - .3 AWS W1-2000, Welding Inspection Handbook..
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-48.2-1992, Spot Radiography of Welded Butt Joints in Ferrous Materials.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA B51-2003, Boiler, Pressure Vessel and Pressure Piping Code.
 - .2 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.

1.2 QUALIFICATIONS

- .1 Welders
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use only fifteen (15) years experienced qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
 - .3 Furnish welder's certifications and qualifications to Departmental Representative prior to commence the work.
 - .4 Each welder to possess identification symbol issued by authority having jurisdiction.

1.3 QUALITY ASSURANCE

- .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.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

Part 2 Products

2.1 ELECTRODES

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

Part 3 Execution

3.1 WORKMANSHIP

- .1 Welding: in accordance with ANSI/ASME B31.1, 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 applicable requirements of provincial authority having jurisdiction.
- .2 The Contractor is to ensure that for any pipe welding that occurs within the interior of the laboratory facility, proper ventilation for the welding system is in place, and under no circumstances shall the welding fumes be transferred to the any area of Museum at any time; Contractor is fully responsible to monitor and maintain facility pressurization as per original design

3.2 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.

3.3 SPECIALIST EXAMINATIONS AND TESTS

- .1 General
 - .1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
- .2 Hydrostatically test welds to requirements of 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 Departmental Representative of total of up to 25% of welds, selected at random by particle tests.
- .5 Full radiographic tests for piping systems.
 - .1 Spot radiography to CAN/CGSB-48.2.
 - .1 Conduct spot radiographic tests of up to 25% of welds, selected at random by Departmental Representative from welds which would be most difficult to repair in event of failure after system is operational.
 - .2 Radiographic film:
 - .1 Identify each radiographic film with date, location, name of welder, and submit to Departmental Representative. Replace film if rejected because of poor quality.
 - .3 Interpretation of radiographic films:
 - .1 By qualified radiographer.
 - .4 Failure of radiographic tests:
 - .1 Extend tests to welds by welder responsible when those welds fail tests.

3.4 DEFECTS CAUSING REJECTION

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

3.5 REPAIR OF WELDS WHICH FAILED TESTS

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

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 00 50 – General Instructions.
- .2 Section 23 05 54 - Mechanical Identification.

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-2001, 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 00 50 – General Instructions.
- .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 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect, separate and place in designated containers for recycling Metal and Plastic.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.
- .2 Ranges: as indicated.

2.2 THERMOMETER

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: stainless steel.
- .3 Stem Type Thermometer: to CGSB 14-GP-2a and as follows:
 - .1 Type: Type C - any angle, adjustable.
 - .2 Class: Class 2 - fixed calibration.
 - .3 Case Material: steel, protected against corrosion and painted black.
 - .4 Crystal: shatterproof glass.
 - .5 Case Length: 225 mm
 - .6 Capillary Tube: Liquid in glass "Red Fluid", mercury free;
 - .7 Graduations: °C.
 - .8 Scale Range:
 - .1 Hot Water Heating: 0-110°C.
 - .2 Condenser Water: 0-50°C.
 - .3 Domestic Hot Water: 0-110°C.
 - .4 Domestic Cold Water: 0-50°C.
- .4 Thermometer Wells: to CAN/CGSB 14.5-M88 and as follows:
 - .1 Construction: one piece brass construction.
 - .2 Diameter: 6 mm.
 - .3 Depth: to suit thermometer stem.

2.3 Positive PRESSURE GAUGES

- .1 Type: liquid fill.
- .2 Accuracy: accurate within $\pm 1\%$.
- .3 Gauge Size: 125 mm diameter.
- .4 Case Material: steel, protected against corrosion and painted black.
- .5 Crystal: shatterproof glass.
- .6 Mounting: stem mounting at bottom of case.

- .7 Bourdon Tube Material: phosphor bronze.
- .8 Dial Graduations: PSI.
- .9 Scale Range:
 - .1 Hydronic Systems: 0-900 KPa
 - .2 Steam Systems: 0-350 KPa
 - .3 Domestic Water Systems: 0-600 KPa
- .10 Stop: bourdon tube and stop.
- .11 Movement: stainless steel or non-ferrous metal.
- .12 Calibrator: set screw.

2.4 Compound Pressure Gauge:

- .1 Type: compound pressure.
- .2 Accuracy: accurate within $\pm 1\%$.
- .3 Gauge Size: 100 mm diameter.
- .4 Case Material: steel, protected against corrosion and painted black.
- .5 Crystal: shatterproof glass.
- .6 Mounting: stem mounting at bottom of case.
- .7 Bourdon Tube Material: phosphor bronze.
- .8 Low Pressure Steam:
 - .1 Vacuum: 0-400 KPa
 - .2 Pressure: 0-400 KPa
- .9 Hydronic Systems:
 - .1 Vacuum: 0-200 KPa
 - .2 Pressure: 0-800 KPa
- .10 Domestic Water Systems:
 - .1 Vacuum: 0-1200 KPa
 - .2 Pressure: 0-800 KPa

2.5 PITOT FLOW FITTINGS

- .1 Flow Element: Averaging pitot-type of 316 stainless steel.
- .2 Flow Sensor: Consisting of three basic flow sensing chambers.
 - .1 Upstream high pressure chamber.
 - .2 High pressure interpolating tube.
 - .3 Low pressure tube located on the pipe centreline.
- .3 Flow Element Design Criteria:
 - .1 Temperature: Serviceable to 150°C.
 - .2 Pressure: Serviceable to 1725 KPa.
- .4 Accuracy: $\pm 2\%$.
- .5 Flow Element Mounting: Pipe Diameters up to 6"; Welded fitting with flow element supported at one end.
- .6 Flow Element Accessories:
 - .1 Brass shut-off valves on each fitting.
 - .2 Quick disconnect gauge fitting.
 - .3 Metal identification tag attached with a chain. Include following information on tag:
 - .1 Design flow rates.
 - .2 Meter readings for design flow rates.
 - .3 Metered fluid name.
 - .4 Line size.
 - .5 Tag number.
 - .6 Station or location number.

2.6 POSITIVE DISPLACEMENT FLUID METERS

- .1 Positive Displacement Fluid Meters:
 - .1 Type: Designed to be used with the fluid being metered.
 - .2 Case: Bronze construction with cast iron frost-proof, breakaway bottom cap.
 - .3 Register: Hermetically sealed.

2.7 PRESSURE/TEMPERATURE TAPS

- .1 Fitting to allow a 1/4" O.D. plug in gauge to measure temperature or pressure.
- .2 Maximum pressure: 3450 KPa.

- .3 Maximum temperature: 150°C.
- .4 Fitting constructed of:
 - .1 1/2" NPT brass body with hex head screw cap and gasket;
 - .2 Protective screw cap to have retaining strap;
 - .3 Two self-closing valves constructed of norel.
- .5 Test kit including the following:
 - .1 One 65 mm diameter compound pressure gauge with 1/8" O.D. plug-in stem;
 - .2 One 125 mm diameter temperature gauge with 1/8" O.D. plug in stem, range 0 – 110 °C;
 - .3 One 125 mm diameter temperature gauge with 1/8" O.D plug in stem, range 0 – 80°C; and
 - .4 All above in protective carrying case with operating instructions.

Part 3 Execution

3.1 GENERAL

- .1 Provide one pressure gauge per pump. Install taps on pump suction, pump discharge and before strainer. Pipe to gauge with needle valve on each tap.
- .2 For gauges on liquid service, provide tee in piping with bronze pulsation damper and needle valve.
- .3 For steam service, provide a pigtail siphon and needle valve.
- .4 Install positive displacement fluid meters with isolating valves and unions.
- .5 Install pitot flow meters according to manufacturer's installation instructions.

3.2 PRESSURE/TEMPERATURE TAPS

- .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 Provide one pressure/temperature taps test kit.

- .4 Install pressure/temperature taps in the following locations:

- .1 Both sides of two-way control valves;
- .2 All lines to three-way control valves;
- .3 Heat exchanger: at inlet and outlet;
- .4 All control sensor.

3.3 THERMOMETERS

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install wells for balancing purposes.
- .3 Use extensions where thermometers are installed through insulation.
- .4 Stem Type Thermometers:

- .1 Heat exchangers at inlet and outlet;
- .2 Boilers at inlet and outlet;
- .3 All lines to three way control valves;
- .4 Inlets/ outlet of three way mixing valve;
- .5 Inlet/ outlet to domestic hot water heater/tanks; and
- .6 All locations as indicated on drawings.

3.4 METER

- .1 Positive Displacement Fluid Meter:
 - .1 Provide positive displacement meters in the following systems at locations indicated on the drawings:
 - .1 Condensate return.
 - .2 Expansion tank make-up.
- .2 Pitot Flow Fittings:
 - .1 Provide pitot type flow fittings in the following systems at locations indicated on drawings:
 - .1 Heating water system.
 - .2 Condenser water system
 - .3 Steam system
 - .2 Install elements a minimum of ten straight pipe diameters upstream, and three diameters downstream of any elbows. Where flow fittings are installed closer than ten pipe diameters upstream of any elbow, provide straightening vanes. Install straightening vanes in accordance with manufacturer's instruction.

3.5 PRESSURE GAUGES

- .1 Positive Pressure Gauges:
 - .1 Expansion tanks.
 - .2 Domestic cold water supply to the systems
 - .3 Boilers at inlet and outlets.
 - .4 Heat exchangers at inlet and outlet.
 - .5 Upstream and downstream of PRV's
 - .6 Inlet and outlet of liquid side of heat exchangers.
- .2 Compound Pressure Gauges:
 - .1 Suction and discharge of pumps.
 - .2 Steam header
 - .3 Condensate header.
- .3 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .4 Use extensions where pressure gauges are installed through insulation.

3.6 NAMEPLATES

- .1 Install engraved lamicoid nameplates as specified in Section 23 05 54 - Mechanical Identification, identifying medium.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B1.20.1-2001 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 A276-2004, Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B62-2002, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B283-1999, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B505/B505M-2002, 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.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 00 50 – General Instructions.
 - .1 Submit data for valves specified in this section.
- .2 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Division 01 requirements.

1.3 MAINTENANCE

- .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 2.

- .2 Discs: one for every 10 valves, each size, minimum 2.
- .3 Stem packing: one for every 10 valves, each size, minimum 1.
- .4 Valve handles: two 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 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, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: Handwheel.
- .3 NPS 2 and under, plug disc, Class 150, screwed ends:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.
 - .3 Operator: Handwheel.
 - .4 Use for 'Throttling Service'.
- .4 Angle valve, NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
 - .3 Operator: Handwheel.
- .4 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, horizontal lift type, composition disc, Class 150:
 - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
 - .2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.
- .5 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62.
 - .2 Pressure rating: Class125.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
 - .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.
- .6 DRAIN VALVES
 - .1 NPS 2 and under:
 - .1 Globe Type Drain Valves:
 - .1 Body: bronze.
 - .2 Disc: compression stop.
 - .3 Ends: nipple and cap or hose.
 - .2 Ball Type Drain Valves:
 - .1 Body: bronze.
 - .2 Ends: cap and chain.

.7 **CIRCUIT BALANCING VALVES**

.1 **NPS 2 and under:**

- .1 Body Design: suitable for throttling.
- .2 Construction: all metal parts non-ferrous, pressure die cast, non-porous copper alloy.
- .3 Installation: designed to be installed in any direction without affecting flow measurement.
- .4 Functions:
 - .1 Precise flow measurement $\pm 2\%$.
 - .2 Precision flow balancing.
 - .3 Positive shut-off with no drip seat and teflon disc.
 - .4 Drain connections with protective cap.
 - .5 Balancing Connection: "hidden memory" feature to program valve with precision tamper-proof balancing setting.
 - .6 Meter Connection: fittings for connecting a portable differential pressure meter and positive shut-off cocks for each meter connection.
- .5 Balancing Connection: "hidden memory" feature to program valve with precision tamper-proof balancing setting.

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.
- .4 Provide valves as indicated on drawings and following schedule:
 - .1 Globe and Angle Globe Valves:
 - .1 Throttling service.
 - .2 Control device.

- .2 Ball and Quick Opening Valves:
 - .1 Branch take-offs.
 - .2 Shut-off.
 - .3 Isolating Service - Isolate equipments.
 - .4 Chemical pot feeders.
- .3 Swing Check Valves:
 - .1 Discharge or pumps.
 - .2 Backflow prevention.
- .4 Circuit Balancing Valves:
 - .1 Pumps discharge.
 - .2 Branch pipe take-offs from main and sub-mains.
 - .3 As indicated on Drawings.
- .5 Drain Valves:
 - .1 Near main shut-off valves.
 - .2 Low points in piping systems.
 - .3 At equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A49-2006, Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A126-2001, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM B61-1993, Specification for Steam or Valve Bronze Castings.
 - .4 ASTM B62-1993, Specification for Composition Bronze or Ounce Metal Castings.
 - .5 ASTM B85-2003, Specification for Aluminum-Alloy Die Castings.
 - .6 ASTM B209-2004, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS SP-71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .3 MSS SP-82-1992, Valve Pressure Testing Methods.
 - .4 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 00 50 – General Instructions.
 - .1 Submit data for valves specified in this section.
- .2 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Division 01 requirements.

1.3 MAINTENANCE

- .1 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: two 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 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 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 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 to 8, outside screw and yoke (OS&Y), bronze 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 Pressure-lubricated operating mechanism.
 - .6 Operator: Handwheel.

2.3 GLOBE VALVES

- .1 NPS 2 1/2 to 10, OSY:
 - .1 Body: with multiple-bolted bonnet.
 - .2 WP: 125 PSI steam, 200 PSI 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, screwed into body.
 - .6 Stem: bronze to ASTM B62.
 - .7 Operator: Handwheel.

2.4 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 6'-0" above floor in boiler rooms and mechanical equipment rooms.

2.5 CHECK VALVES

- .1 Swing check valves, Class 125:
 - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A126 Class B.

- .2 Ratings:
 - .1 NPS 2 1/2 - 12: 125 PSI steam, 200 PSI CWP.
- .3 Disc: rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B 62.
 - .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 Identification tag: fastened to cover.
- .7 Hinge: galvanized malleable iron.

Part 3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Provide valves as indicated on drawings and following schedule:
 - .1 Gate Valves:
 - .1 Shut-off.
 - .2 Isolating Service - Isolate equipment and vertical risers.
 - .3 Branch take-offs.
 - .2 Globe Valves:
 - .1 Throttling service.
 - .2 Control device.
 - .3 Low water cut-offs.
 - .4 Chemical pot feeders.
 - .3 Swing Check Valves:
 - .1 Discharge or pumps.
 - .2 Backflow prevention.

END OF SECTION

Part 1 General

1.1 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 B16.5-2003, Pipe Flanges and Flanged Fittings.
 - .4 ANSI/ASME B16.11-2001, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25-1997, Buttwelding Ends.
 - .6 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding Ends.
- .2 American National Standards Institute (ANSI)/American Petroleum Institute (API).
 - .1 ANSI/API 609-1997, Lug- and Water-Type Butterfly Valves.
- .3 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A126-2001, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM B62-2002, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B209M-2004, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS SP-67-2002, Butterfly Valves.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 00 50 – General Instructions.
 - .1 Submit data for valves specified this section.
- .2 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Division 01 Requirements.

1.3 MAINTENANCE

- .1 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: two of each size.
 - .5 Gaskets for flanges: one for every 10 flanged 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: Wafer type: NPS 2 to 30.
- .5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
 - .1 NPS 2 to 12: 1378 KPa.
- .6 Minimum seat temperature ratings to 275 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: 316 SS.
- .3 Seat: EPDM.
- .4 Shaft: 316 stainless steel.
- .5 Taper pin: 316 SS.
- .6 Key: stainless.
- .7 O-Ring: Buna-N.
- .8 Bushings: Teflon.

2.2 MOUNTING FLANGES

- .1 Class 125 cast iron to ANSI B16.1 or Class 150 steel to B16.5 pipe flanges.

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 ACTUATOR INSTALLATION

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

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 B31.1-2004, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125-2007, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-2004, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-2004, 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 ASME B31.1 or MSS SP58.

- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 00 50 – General Instructions.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .3 Quality assurance submittals: submit following in accordance with Section 01 00 50 – General Instructions.
 - .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 Division 01 Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

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

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.

- .3 Obtain approval from the Departmental Representative prior to drilling for inserts and supports for piping systems.
- .4 Obtain approval from the Departmental Representative prior to using percussion type fastenings.
- .5 Use of piping or equipment for hanger supports is not permitted.
- .6 Use of perforated band iron, wire or chain as hangers is not permitted.
- .7 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Departmental Representative.
- .8 Where deemed necessary by the Departmental Representative the contractor shall, at his own cost, employ a structural consultant to design equipment supports and/or pipe anchors.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
 - .2 Use hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 3/8" UL listed.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, to MSS SP69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut 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 1/4" minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate to MSS SP69.
- .5 Do not use shop and field-fabricated assemblies.
- .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.
 - .3 Do not use 7/8" or 1 1/8" rod.
- .7 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel black.
 - .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, 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: black, with formed portion epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ 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 305 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.4 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.

2.5 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13mm 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.
- .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.

2.6 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements Structural Steel for Buildings.

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.8 HOUSE-KEEPING PADS

- .1 Provide high concrete housekeeping pads for base-mounted equipment; size pads as indicated on drawings and as per shown structural detail.

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, and as indicated.
- .3 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .5 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more.
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .6 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25% of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code and authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1800 mm.

- .4 Copper piping: up to NPS 1/2: every 1500 mm.
- .5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .6 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1m	1.8m
1-1/2	2.7m	2.4m
2	3.0m	2.7m
2-1/2	3.6m	3.0m
3		
3-1/2	3.9m	3.3m
4	4.2m	3.6m
5	5.1m	Do Not Use
6		
8	5.4m	
10	6.0m	
12	6.6m	

- .7 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 FLASHING

- .1 Flash and counter flash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.
- .2 Flash floor drains over finished areas with lead minimum 250 mm clear on sides. Fasten flashing to drain clamp device.
- .3 Provide curbs for mechanical roof installations.
- .4 Attach counter flashings to mechanical equipment and lap base flashings on roof curbs.
- .5 All joints in counter flashings shall be flattened and soldered double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Use storm collars above all roof jacks.

3.7 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 SUMMARY

- .1 Section ioncludes:
 - .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 13-2010, Standard for the Installation of Sprinkler Systems.
- .3 National Building Code of Canada (NBC) - 2010

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 00 50 – General Instructions.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 50 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Submit shop drawings in accordance with Section 01 00 50 – General Instructions.
 - .1 Provide separate shop drawings for each isolated system complete with performance and product data.
- .3 Quality assurance submittals: submit following in accordance with Section 01 00 50 – General Instructions.
 - .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 materials in accordance with manufacturer's written instructions.

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-steel-neoprene; 12 mm minimum thick neoprene bonded to 1/4" steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 75 PSI.

2.3 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .3 Performance: as indicated.

2.4 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

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

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.

- .2 Ensure piping 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.
 - .2 NPS5 to NPS8: first 4 points of support.
 - .3 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.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 Upon completion of installation.
 - .3 Submit manufacturer's reports to Departmental Representative within seven (7) days of manufacturer representative's review.
 - .4 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification:
 - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC system[s] after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .2 Provide Departmental Representative with notice ninety-six (96) hours in advance of commencement of tests.

- .3 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
- .4 Submit complete report of test results including sound curves.

3.4 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.5 ISOLATION SCHEDULES

Isolated Equipment		Type of	Static
No.	Description	Isolation	Min. Deflection (Inch)
FLC-1	Drycooler	EP-1	-
Vertical In-Line Pumps	General	H-2	3/4

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-1997, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-1992, Identification of Piping Systems.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.

1.3 SUBMITTALS

- .1 Product Data: in accordance with Section 01 00 50 – General Instructions.
- .2 Product data to include paint colour chips, other products specified in this section.
- .3 Samples:
 - .1 Submit samples in accordance with Section 01 00 50 – General Instructions.
 - .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 00 50 – General Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Do not dispose of unused paint, coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 EXISTING IDENTIFICATION SYSTEMS

- .1 Where existing identification system does not cover for new work, use identification system specified this section.
- .2 Before starting work, obtain written approval of identification system from Departmental Representative.

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

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

2.3 SYSTEM NAMEPLATES

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

Size #	Sizes (inch)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5

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

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

.4 Identification for:

.1 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

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

.2 Equipment elsewhere: sizes as appropriate.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Sprinklers: to NFPA 13.

.2 Natural gas: to CSA/CGA B149.1-2005.

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 NPS 75mm long x 50 mm high
- .2 Outside diameter of pipe or insulation NPS 3 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 3/4" and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
- .2 Other pipes: pressure sensitive plastic-coated cloth with protective over-coating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 120°C and intermittent temperature of 180°C.
- .7 Colours and Legends:
- .1 Where not listed, obtain direction from Departmental Representative.
- .2 Colours for legends, arrows: to following table:

Background Colour:	Legend, Arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
Treated water	Green	TREATED WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Steam ___ KPa	Yellow	___ PSI STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Yellow	ST.COND.RET (PUMPED)
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Sprinklers	Red	SPRINKLERS
Natural gas	As per Natural Gas code CSA B149.1-05	

2.6 VALVES, CONTROLLERS

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

2.7 CONTROLS COMPONENTS IDENTIFICATION

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

2.8 LANGUAGE

- .1 Identification in English.

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 or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

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

3.5 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 30'-0" 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 On both sides of visual obstruction or where run is difficult to follow.
- .4 On both sides of separations such as walls, floors, partitions.

- .5 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .6 At beginning and end points of each run and at each piece of equipment in run.
- .7 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.
- .8 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 Departmental Representative and provide one (1) 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 Division 01 Requirements.
- .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 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Departmental Representative within ninety (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.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

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

1.5 COORDINATION

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

1.6 PRE-TAB REVIEW

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

1.7 START-UP

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

1.8 OPERATION OF SYSTEMS DURING TAB

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

1.9 START OF TAB

- .1 Notify and coordinate with Departmental Representative **fifteen (15) working days** prior to start of TAB.
- .2 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 Hydronic 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 Hydronic systems: +/- 5%.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 5% of actual values.

1.12 INSTRUMENTS

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

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

1.15 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 five (5) copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, 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.

1.17 COMPLETION OF TAB

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

1.18 HYDRONIC SYSTEMS

- .1 Definitions: for purposes of this section, to include low pressure hot water heating, condenser water, glycol systems.
- .2 Standard: TAB to be to most stringent of this section or TAB standards of AABC.
- .3 Do TAB of following systems, equipment, components, controls:
 - .1 Balance all flows at all pumps. Provide PV data for all pumps.
 - .2 Provide recommendations on impeller trimming for all pumps, re-measure pump performance after impeller trimming is complete.
 - .3 Provide PV measurements for heat exchangers, preheat coil, heating coil.

- .4 Adjust flow of water through heat exchanger.
- .5 Check and record leaving water temperatures and return water temperatures, and pressure drop through heat exchangers. Reset to design temperatures.
- .6 Check and record water temperature at inlet side of coils. Note rise or drop of temperatures from source.
- .7 Position and mark all automatic valves, hand valves, and balancing cocks for design flow through all coils, connectors and all items in the system requiring circulation of chilled water, hot water or glycol.
- .8 Ensure all bypass valves are tightly closed.
- .4 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of primary and secondary loops (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.

1.19 DOMESTIC SYSTEMS

- .1 Meet requirements as specified for hydronic systems.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Inlet and outlet of heaters, tank, pump, circulator, at controllers, controlled device.

1.20 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for hydronic systems specified this section.
 - .2 Quality assurance: as for hydronic systems specified this section.
- .2 Laboratories fume hoods:
 - .1 Standard: Canada Labour Code or Territorial standard.
 - .2 TAB procedures: as described in standard.
- .3 Measurement of noise and vibration from equipment specified in Division 23.

Part 2 **Products - Not Applicable**

Part 3 **Execution - Not Applicable**

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-10, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C335-05, Standard Test Method for Steady State Heat Transfer Properties of Horizontal 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 C533-04, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-06, Mineral Fiber Pipe Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 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.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Trade Associations

- .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards-04.

.6 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702-97, Thermal Insulation, Mineral Fibre, for Buildings
- .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:

- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC Codes:

- .1 CRF: Code Rectangular Finish.
- .2 CPF: Code Piping Finish.

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 01 00 50 – General Instructions.

.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.3 Shop Drawings:

- .1 Submit shop drawings in accordance with Section 01 00 50 – General Instructions.

.4 Quality assurance submittals: submit following in accordance with Section 01 00 50 – General Instructions.

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

1.5 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least fifteen (15) years successful experience in this size and type of project, qualified to standards of TIAC.

1.6 DELIVERY, STORAGE AND HANDLING

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

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 All Insulation products shall be "**Mold Resistant**" no alternative will be accepted, contractor shall supply written confirmation accompany with the shop drawings.
- .2 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .3 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .4 Type 1: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Jacket: to CGSB 51.9.

- .3 Maximum "k" factor: to 0.035 W/m.C and to CAN/ULC-S702.
- .4 Services Temperature: up to 160°C
- .5 Type 6: Flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: .035 W/m.C.
 - .4 Service Temperature: -4°C to 100°C
 - .5 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.

2.3 INSULATION SECUREMENT

- .1 All Adhesive shall meet the environmental choice guideline CCD-046 or the California south coast air quality management Rule No. 1168.
 - .1 Tape: self-adhesive, aluminium, plain, 50 mm wide minimum.
 - .2 Contact adhesive: quick setting.
 - .3 Tie wire: 1.5 mm diameter stainless steel.
 - .4 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Air drying on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 JACKETS

- .1 Use of Canvas is not allowed.
- .2 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint by Architect.
 - .3 Minimum service temperatures: -40 degrees C;
 - .4 Maximum service temperature: 200 degrees C;
 - .5 Moisture vapour transmission: 0.02 perm
 - .6 Thickness: 0.5 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .3 Aluminum:
 - .1 To ASTM B209
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: smooth.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps
 - .5 Fittings: 0.50 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.50 mm thick at 300 mm spacing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

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

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

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

3.5 INSTALLATION OF ELASTOMERIC INSULATION

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

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Type A:

- .1 Type 1 insulation without factory applied vapour retarder.
- .2 Securements: SS wire at 300 mm on centre. Pipe insulation with integral jacket shall be held in place by stapling the flaps on 75mm centres. Pipe insulation with integral self-sealing jacket will not require additional fastening.
- .3 Seals: not required.
- .4 Fittings: miter pipe insulation to fit tightly, or insulating cement, or with tightly placed flexible insulation covered with reinforcing membrane stapled in place. Alternately insulate fitting with tightly placed flexible insulation and apply aluminium fitting covers.
- .5 Valves, Strainers: where indicated on the particular product schedule, insulate valve bodies and strainers with insulating cement or fitted pipe insulation segments or mitred blocks al to thickness of adjacent pipe insulation or insulate with tightly placed flexible insulation covered with reinforcing membrane stapled in place. Drains, blow-off plugs and caps shall be left uncovered. Alternately insulate with tightly placed insulation and apply aluminium fitting covers.
- .6 Flanges: where indicted insulate flanges with oversized pipe covering or mitred blocks to and applied in accordance with the manufacturers directions. Alternately insulate with tightly placed flexible insulation and apply aluminium fitting covers.
- .7 Insulation termination points: terminate insulation 75 mm from fittings to provide working clearance and bevel insulation at 45 degree angle.
- .8 Installation: TIAC Code: 1501-H.

.3 Type B:

- .1 Type 6 insulation.
- .2 Insulation securements: glue all joints in accordance with manufacturer's instructions.
- .3 Seals: lap seal adhesive, lagging adhesive.
- .4 Installation: TIAC Code: 1501-CA.

.4 Thickness of insulation as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 3600 mm long.

Application	Temp °C	Code	NPS Pipe sizes (Ø) and insulation thickness (mm)					
			Run out	Up to 1	1 1/4 to 2	2 ½ to 4	5 & 6	8& over
Domestic DHW/ DHWR with or without vapour retarder	60–94	A	25	40		50		
Heating Glycol (Supply / Return)	60–94	A	25	40		50		
Heating Steam, Saturated and Super heated From Boilers plant	up to 175	A	40	50	65	75	100	
Condensate Return to Boilers Plant	60 to 94	A	25	40				
Domestic DCW with or without vapour retarder	2 to 10	B	25					

.5 Finishes:

- .1 Exposed indoors: PVC jacket or aluminum unless otherwise specified.
- .2 Exposed in mechanical rooms: PVC jacket or aluminum unless otherwise specified
- .3 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
- .4 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

- .1 Proceed in accordance with Division 01 Requirements.
- .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 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 American Society for Testing and Materials (ASTM International)
 - .1 ASTM B209M-06, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C335-05, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-05, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-01, Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-06, Specification for Mineral Fiber Pipe Insulation.
 - .7 ASTM C553-02, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .8 ASTM C612-04, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .9 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .10 ASTM C921-03a, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CGSB 51-GP-53M-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

- .4 Thermal Insulation Association of Canada (TIAC)
 - .1 National Insulation Standards-04.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 PRODUCT DATA

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

1.3 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section, and have at least fifteen (15) years successful experience in this size and type of project, qualified to standards of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, corrugated cardboard, packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
- .3 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

Part 2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 All Insulation products shall be "**Mold Resistant**" no alternative will be accepted, contractor shall supply written confirmation accompany with the shop drawings.
- .2 Mineral fibre: includes glass fibre, rock wool, slag wool.
- .3 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .4 **Type A:** Rigid mineral fibre blanket to CAN/CGSB-51.11 and suitable for curved surfaces
 - .1 Insulation: ASTM C533.
 - .2 Maximum "k" factor: maximum 0.035 W/hr.ft².F and as per ASTM C533.
 - .3 Hot Equipment Service Temperature: 20°C to 160°C.

2.3 CEMENT

- .1 Thermal insulating and finish
 - .1 To: ASTM C449/C449M.
 - .2 Air drying on mineral wool, to ASTM C449.

2.4 JACKETS

- .1 Use of Canvas is not allowed.
- .2 Aluminum:
 - .1 To ASTM B209
 - .2 Thickness: 0.5 mm Sheet.
 - .3 Finish: smooth.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps
 - .5 Fittings: 0.50 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.5 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm inch wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Tie wire: 1.5 mm diameter stainless steel.
- .4 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
- .5 Facing: 25 mm galvanized steel hexagonal wire mesh on both faces of insulation.
- .6 Fasteners: 4 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

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

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards
 - .1 Hot equipment: To TIAC code 1503-H.
- .2 Provide vapour retarder as recommended by manufacturer.
- .3 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- .4 Cover insulation with 25 mm galvanized hexagonal mesh and 12 mm coat of insulating cement. Finish with a final 12 mm coat of finishing cement and recover with canvas.
- .5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports outside vapour retarder jacket.
- .7 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 EQUIPMENT INSULATION SCHEDULES

- .1 Heat Exchangers:
 - .1 Type A: un-faced with wire or bands and 13 mm cement precede by one layer of reinforcing mesh.
 - .2 Thickness: 50 mm.
- .2 Finishes:
 - .1 Equipment in mechanical rooms: TIAC code CEF/1 with aluminum jacket.

3.4 CLEANING

- .1 Proceed in accordance with Section Division 01 Requirements.
- .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 Related Sections:

- .1 Section 23 05 93 - Testing, Adjusting and Balancing (TAB).

1.2 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.

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

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

1.4 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 seventy-two (72) 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 Pumps operation.
 - .2 Boilers Operations and failure,
 - .3 Pressure bypass open/closed.
 - .4 Control pressure failure.
 - .5 Maximum heating demand.
 - .6 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.5 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.
 - .1 Test procedures:
 - .1 Open fully heat exchanger, heating coil and radiation control valves.
 - .2 With boilers on full firing and hot water heating 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.

1.6 GLYCOL SYSTEMS

- .1 Test to prove concentration will prevent freezing to minus 35°C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.7 REPORTS

- .1 In accordance with Section 01 00 50 – General Instructions: Reports, supplemented as specified herein.

Part 2 Products - Not Applicable

Part 3 Execution - Not Applicable

END OF SECTION

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 E202-2000, 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 00 50 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 00 50 – General Instructions.

Part 2 Products

2.1 CLEANING SOLUTIONS

- .1 Contractor shall contact the facility's current supplier and use only similar product no other alternative will be accepted.

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 AND STEAM SYSTEMS

- .1 Timing:
 - .1 Systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
 - .1 Retain only current approved facility 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.
- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least four (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 As per current standard practice of the facility, coordinate with facility O&M team.
- .2 Establish circulation, raise temperature slowly to maximum design. Circulate for twelve (12) hours ensuring flow in all circuits; 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).

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 Mechanical System.
- .12 Adjust pipe supports, hangers, springs as necessary.
- .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .15 Check operation of drain valves.

- .16 Adjust valve stem packings as systems settle down.
- .17 Fully open balancing valves (except those that are factory-set).
- .18 Check operation of over-temperature protection devices on circulating pumps.
- .19 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 Division 01 requirements.
- .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 Society of Mechanical Engineers (ASME).
 - .1 ASME-2004, Boiler and Pressure Vessel Code.
- .2 American Society for Testing and Materials, (ASTM).
 - .1 ASTM A47/A47M-2004, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A278M-2006, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
 - .3 ASTM A516/A516M-1999, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A536-2003, Specification for Ductile Iron Castings.
 - .5 ASTM B62-1993, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International).
 - .1 CSA B51-2003, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 00 50 – General Instructions.
 - .1 Indicate on product data expansion tanks, air vents, air-separators, valves, strainers.
- .2 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 00 50 – General Instructions.

Part 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

- .1 Vertical steel pressurized diaphragm type expansion tank.
- .2 Diaphragm sealed in EPDM suitable for 115°C operating temperature.
- .3 Working pressure: 860 KPa with ASME stamp and certification.
- .4 Air pre-charged to 84 KPa (initial fill pressure of system).

- .5 Base mount for vertical installation.
- .6 Supports: provide supports with hold down bolts and installation templates.

2.2 AUTOMATIC AIR VENT

- .1 Provide automatic float type with isolating valve, semi-steel body, copper float, stainless steel valve and valve seat, suitable for system operating temperature and pressure.
- .2 Float: solid material shall be suitable for maximum working pressure of 1035 KPa and 150°C working temperature.
- .3 All air vents in concealed spaces: Provide vent tubing to nearest drain.

2.3 AIR SEPARATOR - EXPANSION TANK FITTING

- .1 Cast iron body and cover, stainless steel bolts and nuts, bronze pilot mechanism.
- .2 Complete with adjustable vent tube and built-in manual vent valve.
- .3 Working pressure: 860 KPa.

2.4 AIR SEPARATOR - IN-LINE

- .1 Provide centrifugal type with 860 KPa WSP/ 115°C OPT steel tank, galvanized steel 5 mm perforated strainer, perforated stainless steel air collector tube and drain connection.
- .2 Size: as indicated.

2.5 COMBINATION CHECK AND SHUT-OFF VALVE (TRIPLE-DUTY VALVE)

- .1 Provide angle or straight type with screwed or flanged cast iron body, and bronze disc, Stainless steel stem spring, EPDM seat & O-ring, Brass port fitting.
- .2 Size: as indicated.

2.6 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.
- .2 NPS 2 1/2 to 10: cast steel body to ASTM A278M, Class 30, flanged connections.
- .3 Blow-down connection: NPS 1.
- .4 Screen: stainless steel with 1.3 mm perforations.
- .5 Working pressure: 860 KPa.

2.7 SUCTION DIFFUSER

- .1 Body: flanged connections, strainer: with built-in stainless steel disposable 3 mm perforations, fine Galvanized steel mesh, cast iron guide vane, low pressure drop screen.
- .2 Size: as indicated.

2.8 RELIEF VALVES

- .1 Provide ASME rated direct spring loaded type, lever operated non-adjustable factory set discharge pressure as indicated.

2.9 COMBINATION SEPARATORS/STRAINERS

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

2.10 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: 206 KPa relief, 55 to 180 KPa reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

2.11 FLEXIBLE CONNECTORS

- .1 Flexible connectors shall consist of close pitch corrugated bronze hose with single layer of exterior braiding to provide additional strength and prevent elongation of corrugated section.
- .2 Connectors shall be minimum 200 mm long and provided with bronze fittings to facilitate connection to equipment.

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 drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow Departmental Representative directive.
- .5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump if suction diffuser is not being used or shown.

3.3 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.
- .3 Use automatic float type at system high points not readily accessible for servicing.
- .4 Where large air quantities can accumulate, provide enlarged air collection standpipes.
- .5 For float type air vents provide vent tubing to nearest drain.

3.4 EXPANSION TANKS

- .1 Adjust expansion tank pressure to suit design criteria.

3.5 PRESSURE SAFETY RELIEF VALVES

- .1 Provide relief valves on pressure tanks, low pressure side of reducing valves, heating convertors, expansion tanks and where indicated.
- .2 Drain relief valve to nearest floor drain.
- .3 System relief valve capacity shall equal make-up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.
- .4 Where one line vents several relief valves, cross sectional area shall equal sum of individual vent areas.

3.6 SUCTION DIFFUSERS

- .1 Install on inlet to pumps having suction size greater than 50Ø mm.
- .2 Support fitting with floor mounted pipe and flange support to eliminate undue stress on pump suction connection

3.7 COMBINATION CHECK AND SHUT-OFF VALVE

- .1 Provide on discharge side of base in-line vertical pumps and where indicated.

3.8 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems, supplemented as specified herein.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3-1998, Malleable Iron Threaded Fittings.
 - .3 ASME B16.5-2003, Pipe Flanges and Flanged Fittings.
 - .4 ASME B16.9-2001, Factory-Made Wrought Buttwelding Fittings.
 - .5 ASME B18.2.1-2003, Square and Hex Bolts and Screws (Inch Series).
 - .6 ASME B18.2.2-1999, Square and Hex Nuts (Inch Series).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A47/A47M-2004, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-2002, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A536-1999, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B61-2002, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62-2002, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E202-2000, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111-2000, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242-2005, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CAN/CSA W48-2006, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 00 50 – General Instructions.

.2 Closeout Submittals.

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 23 and 39 - Closeout Submittals and include following:

.1 Special servicing requirements.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, as follows:

.1 NPS 2 and under, continuous weld, **Sch. 40 or 80**, standard weight and as indicated.

.2 NPS 2 1/2 and over, Grade B, electric resistance weld, **Sch. 40 or 80**, standard weight and as indicated.

2.2 PIPE JOINTS

.1 NPS2 and under: screwed fittings with teflon tape or pulverized lead paste.

.2 NPS2-1/2 and over: welding fittings and flanges to CSA W47.1 and CSA W47.1S1.

.3 Flanges: plain weld neck.

.4 Flange gaskets: to ANSI/AWWA C111/A21.11.

.5 Pipe thread: taper.

.6 Bolts and nuts: to ANSI/ASME B18.2.1 and ANSI/ASME B8.2.2.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ANSI/ASME B16.1, Class 150.

.2 Steel: to ANSI/ASME B16.5.

.3 Butt-welding fittings: steel, to ANSI/ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M or ductile iron to ASTM A536.

2.4 VALVES

- .1 See related Sections 23 05 22, 23 05 23 and 23 05 26.

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 INSTALLATION

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

3.3 CIRCUIT BALANCING VALVES

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

3.4 CLEANING, FLUSHING AND START-UP

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

3.5 TESTING

- .1 Test system in accordance with Section 23 05 05 – Installation of Pipework.

3.6 BALANCING

- .1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for Mechanical System for applicable procedures.

3.7 PERFORMANCE VERIFICATION

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

3.8 CLEANING

- .1 Proceed in accordance with Division 01 requirements.
- .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 SECTION INCLUDES

- .1 Materials, equipment selection, installation and start up for hydronic system pumps.

1.2 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 Standard 90.1-2010 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .3 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B214-2001, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA MG 1-2003, Motors and Generators.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 00 50 – General Instructions.
- .2 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.
- .3 Submit product data of pump curves for review showing point of operation.
- .4 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.
- .5 Provide maintenance data for incorporation into manual specified in Section 01 00 50 – General Instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 00 50 – General Instructions.

Part 2 Products

2.1 IN-LINE CIRCULATORS

- .1 Pump shall be suitable for use in domestic hot water system, Bronze Fitted with bronze impeller.
- .2 The pump shall be maintainable using an silicon seal carbide mechanical seal, have a close coupled dry motor.
- .3 Motor shall have a minimum wire-to-water efficiency of 36%.
- .4 Capacity: as indicated on the schedule.

2.2 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: bronze, fully enclosed type impeller shall be dynamically balanced.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: shall be single spring inside type with carbon against o-ring mounted Ni resist faces. EPDM elastomer with stainless steel spring and hardware shall be provided.
- .5 Seal vent line shall be factory installed and shall be piped from seal area to the pump suction.
- .6 Bearings: oil lubricated ball or roller and thrust bearings with oil reservoir, oil seals with integral dirt and water seals at each end of reservoir; rated for minimum life of 10,000 hours.
- .7 Coupling: rigid self-aligning.
- .8 Motor: resilient mounted, sleeve bearing, 1,800 r/min, kW (HP) as indicated.
- .9 Design pressure: 1034 kPa maximum working pressure.
- .10 Capacity: as indicated on the schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide drains for bases and stuffing boxes, piped to and discharging into floor drains.
- .2 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.
- .3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

- .4 Support "in-line" circulators directly from inlet and discharge pipe. Do not use flexible connections.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.

3.2 START-UP

- .1 General
 - .1 In accordance with manufacturer's recommendations.
- .2 Procedures:
 - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 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 twelve (12) continuous hours.
 - .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 at all times.
 - .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.

3.3 PERFORMANCE VERIFICATION (PV)

- .1 Exclusions:
 - .1 This paragraph does not apply to small in-line circulators.
- .2 Assumptions: these PV procedures assume that:
 - .1 Manufacturer's performance curves are accurate.
 - .2 Valves on pump suction and discharge provide tight shut-off.
- .3 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 the Standard.
 - .3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.
- .4 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

3.4 OPERATION REQUIREMENTS

- .1 Operational requirements in accordance with Division 01.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

- .1 Materials and installation for piping and fittings used in HVAC heat exchangers.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

- .1 ASME Boiler and Pressure Vessel Code.

- .1 BPVC-VIII B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.

- .2 BPVC-VIII-2 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.

- .3 BPVC-VIII-3 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.

.2 Canadian Standards Association (CSA International)

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

.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 00 50 – General Instructions.

- .1 Submit manufacturer's printed product literature, specifications and datasheet for heat exchangers.

- .2 for adhesive and solvents during application and curing.

.2 Shop Drawings:

- .1 Submit shop drawings to indicate project layout including layout, dimensions of heat exchangers and system. Indicate following information:

- .1 Manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.

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

- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Manufacturer's Field Reports: manufacturer's field reports specified.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Division 01 requirements.

1.4 MAINTENANCE

- .1 Supply following spare parts:

- .1 Head gaskets.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

Part 2 Products

2.1 PLATE HEAT EXCHANGER

- .1 General:
 - .1 Water to 50% ethylene glycol.
 - .2 Designed, constructed and tested in with accordance ASME Boiler and pressure Vessel Code, Section VIII, CSA B51 and provincial pressure vessel regulations.
- .2 Frames: carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.
- .3 Plates: type 304 stainless steel, minimum thickness 10mm.
- .4 Tie Rods: Zn coated steel.
- .5 Shroud: Aluminum.
- .6 Gaskets: as recommended by manufacturer to suit fluid temperature.
- .7 Nozzles: as indicated on drawings
- .8 Supports: as indicated on drawings
- .9 Piping connections: as indicated on drawings

- .10 Design to operate at 690 kPa and rated for 900 kPa with and maximum operating temperature of 100°C.
- .11 Capacity: as indicated on the equipment schedule.

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 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.
- .2 Plate heat exchangers: arrange piping so that exchanger can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

3.3 APPURTENANCES

- .1 Install with safety relief valve piped to drain, vacuum breaker, steam trap.
- .2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.
- .3 Install pressure gauge on steam inlet.

3.4 FIELD QUALITY CONTROL

- .1 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 product[s], 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.
- .2 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within three (3) days of review and submit immediately to Departmental Representative.

.4 Start-up:

- .1 General: perform start-up operations in accordance with Division 01- General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Check heater for cleanliness on primary and secondary sides.
- .3 Check water treatment system is complete, operational and correct treatment is being applied.
- .4 Check installation, settings, operation of relief valves and safety valves.
- .5 Check installation, location, settings and operation of operating, limit and safety controls.
- .6 Check supports, seismic restraint systems.

.5 Performance Verification:

- .1 General: perform performance verification in accordance with Division 01 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
- .2 Timing: only after TAB of hydronic systems have been successfully completed.
- .3 Primary side:
 - .1 Measure flow rate, pressure drop, and either steam pressure and temperature at heater inlet and water temperature at heater inlet and outlet.
 - .2 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.
- .4 Control valve: verify proper operation without binding, slack in components. Measure either steam pressure and temperature at control valve inlet.
- .5 Simulate heating water temperature schedule and repeat above procedures.
- .6 Verify settings, operation, safe discharge from safety valves and relief valves.
- .7 Verify settings, operation of operating, limit and safety controls and alarms.
- .8 Reports:
 - .1 In accordance with Division 01 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

3.5 CLEANING

- .1 Perform cleaning operations as specified in Division 01 requirements.
- .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 Included:

- .1 Materials, components, framing, installation and testing for a closed circuit drycooler.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- .1 Anchor bolts: size anchor bolts to withstand seismic acceleration and velocity forces as defined in 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

1.4 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A48/A48M, Standard Specification for Gray Iron Castings.
 - .2 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .4 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - .5 ASTM D520, Standard Specification for Zinc Dust Pigment.
 - .6 ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - .7 ASTM F594, Standard Specification for Stainless Steel Nuts.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B52, Mechanical Refrigeration Code.
- .3 American National Standards Institute (ANSI)
 - .1 ANSI S1.13, Methods for the Measurement of Sound Pressure Levels.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

- .5 Underwriters Laboratories' of Canada (ULC).
 - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .6 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1, Industrial Control and Systems.
 - .2 NEMA ICS 2, Industrial Control and System Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC.
 - .3 NEMA MG 1, Motors and Generators.

1.5 PERFORMANCE REQUIREMENTS

- .1 Dry Coolers:
 - .1 Fill system with water and glycol.
 - .2 Pressure drop: as indicated
- .2 Maximum pump head: as indicated.
- .3 Electrical: maximum full load running amps: as indicated.
- .4 Sound pressure level: as indicated.

1.6 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.

- .2 Indicate:
 - .1 Connections, piping, fittings, valves, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring as assembled and schematically.
 - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
 - .4 Vibration and seismic control measures.
 - .5 Manufacturers recommended clearances.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Test Reports:
 - .1 Submit certified test reports for closed circuit coolers from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Reports: manufacturer's field reports specified.
- .4 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
 - .2 Include:
 - .1 Description of equipment giving manufacturers name, type, model, year, capacity.
 - .2 Start-up and commissioning procedures.
 - .3 Details of operation, servicing and maintenance.
 - .4 Recommended spare parts list.

1.7 QUALITY ASSURANCE

.1 Qualifications:

- .1 Installer: company or person specializing in cooling towers, closed circuit coolers and/or evaporative condensers installations with five (5) years' experience approved by manufacturer.

.2 Regulatory Requirements: work to be performed in compliance with Canadian Environmental Protection Act (CEPA) and Transportation of Dangerous Goods Act (TDGA) and applicable Provincial regulations.

.3 Health and Safety:

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

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.2 Storage and Protection:

- .1 Store materials in dry location.
- .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

.3 Waste Management and Disposal:

- .1 Construction/demolition waste management and disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

1.9 MAINTENANCE

.1 Extra Materials:

- .1 Furnish following spare parts: one fan motor.
- .2 Furnish spare parts data for each different item of equipment specified, after approval of detail drawings, submit with operation and maintenance manual.
- .3 Include with data complete list of parts and supplies, source of supply, recommended spare parts list for one (1) year of operation, and list of parts recommended by manufacturer to be replaced on routine basis.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Section 01 47 15 – Sustainable Requirements: Construction.

2.2 GENERAL

- .1 Factory assembled forced draft closed circuit cooler.
- .2 Ensure major equipment including drive assemblies, fans, and motors have manufacturer's name, address, style, model, serial number, catalogue number on plate secured to item of equipment.
- .3 Plates: durable and legible throughout equipment life and made of anodized aluminium or stainless steel.
- .4 Fix plates in prominent locations with nonferrous screws or bolts.

2.3 SIZE AND WEIGHT

- .1 Dimensions: as indicated.
- .2 Operating weight: as indicated.

2.4 MATERIALS

- .1 Steel: components fabricated of zinc-coated steel not lighter than 1.5 mm thick steel, protected against corrosion by zinc coating.
 - .1 Zinc coating: to ASTM A153/A153M and ASTM A123/A123M, with extra heavy coating of not less than 0.76kg per square meter of surface.
 - .2 Coat galvanized surfaces damaged due to welding with zinc rich coating conforming to ASTM D520, Type 1.
- .2 Fibre glass reinforced plastic, (FRP) components: inert, corrosion resistant, and fire-retardant with thickness of 3.66kg/square meter, with UV inhibitor to CTI standard 137, grade 1 or 3.
- .3 Polyvinyl chloride, (PVC) to ASTM D1784 with flame spread rating of 10, smoke developed of 25, to CAN/ULC-S102.
- .4 Stainless steel: type 316.
- .5 Plastic: polypropylene.
- .6 Hardware: Type 304 stainless steel.

.1 Bolts: provided with neoprene and stainless steel washers under heads.

.2 Hardware: meet salt-spray fog test as defined by ASTM B117.

2.5 CASING AND FRAMEWORK

.1 Materials: galvanized steel sheet, angles and channels.

.2 Structure: designed for wind loads of 1.6kPa on projected area and transmission of loads to anchorage. Fan decks designed to withstand this live load plus concentrated over distributed loads of equipment mounted on the fan decks.

.1 Include 15% increased loading for ice or snow load.

.3 Access doors on both end walls for servicing and maintenance.

.4 Provide steel hand railings minimum 1067 mm high around exterior of each working surface that is 3.66 m or more above ground, roof, or other supporting construction.

.1 Railings: minimum 32 mm zinc-coated steel pipe with standard zinc-coated steel railing.

2.6 COIL SECTION

.1 Tube bundle: copper, type M, isolated from steel support with poly propylene spacers or steel tubing and supporting steel framework hot-dip galvanized after fabrication.

.2 Factory test to 2.4mPa under water.

.3 Coil pressure drop: as indicated.

2.7 FAN

.1 Fans shall be fixed-pitch propeller type, constructed of zinc-coated steel. Type 304 stainless steel, aluminium or an aluminium alloy, or FRP. Propeller type shall have a maximum tip speed of 55 m/s. Fan blade assembly shall be both statically and dynamically balanced. Fan hub shall be constructed of stainless steel or cast aluminium with adequate surface protection against corrosion.

.1 Complete fan assembly (fan and mounting) shall be designed to give maximum fan efficiency and long life when handling saturated air at high velocities.

.2 Fan Motor

.1 Each motor shall be a single, TEFC, insulation Class B, NEMA Design B, continuous-rated, and conforming to NEMA MG 1. Fan motors shall have totally enclosed enclosures and be located outside the discharge airstream.

.2 Motors shall be mounted according to manufacturer's recommendations.

- .3 Motors shall be designed for inverter duty and shall be suitable for use with variable frequency drive.

2.8 ACCESSORIES

- .1 Temperature controller: in pan, set at 10 degrees C with sensor to cycle fans.
- .2 Time delay relay: to limit fan motor starts to not more than six (6) hours.
- .3 Capacity control: scroll damper and modulating electronic damper motor, controlled by temperature controller. Sensor in pan set at 10 degrees C.

2.9 VIBRATION ISOLATORS

- .1 To Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.10 CONTROLS

.1 Control Panel

- .1 Provide a control panel specifically designed to control fans. Panel shall:
 - .1 Have lockable hinged front door.
 - .2 Be constructed to NEMA Type 1 standards.
 - .3 Contain disconnects for motor.
 - .4 Contain contactors, relays, 120 volt control transformers, terminal blocks and all other electrical devices.
 - .5 Have a wiring and schematic diagram inside starter enclosure in visible location. Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .6 Control panel shall:
 - .1 Receive signals from Owner's DDC system to stop and start cooler and to provide a 4-20 ma or 0-10 VDC control input to reset glycol supply temperature.

.2 Vibration Limit Switch

- .1 Provide a vibration limit switch to shut down tower and provide notification via isolated contacts to the Owner's DDC 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 GENERAL

- .1 Mount on structural supports and vibration isolators as indicated and to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.
- .3 Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.

3.3 ADJUSTING

- .1 Lubricate bearings with oil or grease as recommended by manufacturer.
- .2 Tighten belts to manufacturer's specified tension.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Wipe equipment clean, and remove traces of oil, dust, dirt, or paint spots.
- .3 Maintain system in clean condition until final acceptance.
- .4 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 INTENT

- .1 This Section specifies mechanical requirements relating to the commissioning of components, systems and integrated systems and applies to all sections in Divisions 21, 22, 23 and 25.
- .2 Related Sections:
 - .1 Section 01 00 50 – General Instructions.
- .3 Commissioning of building components and systems is of the utmost importance to ensure the successful operation of this building. The building will not be considered complete until all systems have been demonstrated to work precisely in accordance with the Contract requirements.
- .4 Responsibility for the satisfactory completion of the building and demonstration that the requirements of the commissioning are satisfied rests with the Contractor, who will employ and pay for any specialist supervision, inspection and testing as required, to complete the work described.
- .5 The commissioning process consists of:
 - .1 Component verifications per this Section.
 - .2 System Performance Verification Testing and Demonstration per this Section
 - .3 Integrated System Performance Verification Testing and Demonstration.
- .6 Read this Section in conjunction with related Sections, which specify specific portions of mechanical starting and testing work. Refer also to Division 01.
- .7 Except where otherwise specified, arrange and pay for the testing and related requirements specified in this and related Sections.
- .8 If test results do not conform with applicable requirements, repair, replace or adjust or balance components and systems. Repeat testing as necessary until results acceptable to the Departmental Representative are achieved.

1.2 VERIFICATION AND REPORTING

- .1 General:
 - .1 Component and system Performance Verification Testing shall be conducted per this Section.
 - .2 Integrated system Performance Verification Testing shall be conducted as outlined in Section 01 00 50 – General Instructions.

- .3 Submit completed verification and test reports immediately after inspections and/or tests are performed.
- .4 Record all data gathered on site on approved verification forms with completed shop drawing data.
- .5 Provide the Departmental Representative with original of each completed verification form.
- .6 Maintain one photocopy on site of all data taken during commissioning.
- .7 Maintain one (1) copy of all final starting, testing, balancing and adjusting reports on site up to interim acceptance of the work for reference purposes.
- .8 All final verification forms are to be typewritten.
- .9 Submit to Departmental Representative for approval.
- .10 Make corrections and re-submit as requested by Departmental Representative.

1.3 SCHEDULE

- .1 Prior to starting and testing of components, and systems prepare a schedule for the required testing.
- .2 Provide sufficient notice minimum fourteen (14) calendar days prior to commencing tests.
- .3 Departmental Representative may witness all or any portion of the component testing.
- .4 A Departmental Representative will witness all System and Integrated System tests performed by the Contractor.
- .5 Contractor to be present for and participate in all tests.
- .6 Unless otherwise specified in writing by a Departmental Representative, all testing and related requirements specified herein will be performed prior to the issue of the Interim Certificate of Completion.

1.4 COORDINATION

- .1 Coordinate all sub-trades, manufacturers, suppliers and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.
- .2 Where any components or systems require testing prior to starting, ensure that such work has been completed and approved prior to starting of these components and systems. In particular, the Building Management system requirements specified on drawings and the balancing requirements in Section 23 05 93 shall be coordinated by the Contractor to complete the commissioning requirements

1.5 COMMISSIONING MEETINGS

- .1 Provide the appropriate representation at the scheduled commissioning meetings as outline in Section 01.

1.6 PRESIDING AUTHORITIES

- .1 Starting procedures defined in this section may duplicate verification conducted by presiding authorities. To facilitate expedient turnover of the building, arrange for authorities to witness procedures in a manner that avoids unnecessary duplication of tests.
- .2 Obtain certificates of approval, acceptance and comply with rules and regulations of a authorities having jurisdiction. Provide originals of all certificates to Departmental Representative.

1.7 CORRECTION OF DEFICIENCIES

- .1 Identify, record, resolve and correct all contract deficiencies found during commissioning.

1.8 COMPLIANCE WITH DEFINED PROCEDURES

- .1 Failure to follow the specific instructions defined herein pertaining to correct starting procedures may result in re-evaluation of components by independent testing agency selected by Departmental Representative at contractors expense. Should results reveal components have not been started in accordance with specified requirements, components may be rejected. If required, remove components from site and replace. Replacement components shall also be subject to full starting procedures. Using the same procedures specified on the originally installed components.

Part 2 Products

2.1 CONTRACTOR INSTRUMENTS TESTING

- .1 Provide two-way radios, ladders and other equipment as required to complete the program and as outlined in this Specification.
- .2 Provide all safety equipment required for personnel involved in the starting, testing, adjusting and balancing program.
- .3 Provide a list of equipment and instruments which will be used in starting, testing, adjusting and balancing of mechanical equipment for approval and review by the Departmental Representative
- .4 Use instruments supplied or calibrated by approved laboratory or manufacturer. Show the Departmental Representative the current calibration certificate for each instrument to be used. Provide a copy of the calibration certificates with test reports

Part 3 Execution

3.1 GENERAL

- .1 Contractor and manufacturer start-up and proving to be carried out in accordance with the respective Section.

3.2 COMPONENT VERIFICATIONS

- .1 The component verification forms will be completed by the Contractor as follows:
 - .1 The 'Specified' requirements shall be completed by the Contractor at the shop drawing submission stage.
 - .2 The 'Shop Drawing' information shall be completed by the Contractor at the shop drawing submission stage.
 - .3 The 'Installed' information shall be completed by the Contractor.
- .2 The component verification forms will be provided to the Contractor for information and convenience and will not relieve the Contractor of responsibility for verification of components not included on the verification forms.
- .3 A verification form is to be completed for each component in a system requiring verification.
- .4 Component verification forms will be approved and subject to random verification by the Departmental Representative.

3.3 COMPONENT VERIFICATION FORMS

- .1 For the purposes of this specification the following sample component verification forms have been provided. The forms are attached in Section 23 84 14A.

3.4 SYSTEM PERFORMANCE VERIFICATION TESTING

- .1 All Contractor and manufacturer startup and proving tests are to be completed and approved by the Departmental Representative prior to conducting the defined system Performance Verification Tests.
- .2 All Component verifications related to a given system shall be completed by the Contractor and approved by the Departmental Representative prior to conducting the defined system Performance Verification Test.
- .3 The Contractor will complete the Contractor verification portion of the System Performance Verification Test form prior to notifying the Departmental Representative that the system is ready for verification.

- .4 Attached at the end of this section is a specific example of a System Performance Verification Test. Each system listed on the system test ledger will require a similar level of testing by the Contractor. The Departmental Representative will provide the Contractor with clarification of the test procedure and provide technical assistance prior to the test being performed.
- .5 System Performance Verification tests will be coordinated with Building automation System Trend data and graphs to provide additional documentation of system performance. A hard copy of this data will be attached to the System Performance Verification test document.
- .6 System Performance Verification Testing shall be Scheduled and conducted by the Contractor.
- .7 System Performance Verification Tests as per the verification forms will be conducted in the presence of the Departmental Representative.
- .8 Systems requiring performance verification tests are listed on the ledger following this section.

3.5 SYSTEM PERFORMANCE VERIFICATION TEST FORMS

- .1 Refer to System Test Forms located in the Commissioning Appendix.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes:
 - .1 General requirements that are common to NMS sections found in Division 26.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part I (22th Edition), Safety Standard for Electrical Installations.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01.
- .2 Shop drawings:
 - .1 Submit drawings stamped, dated and signed.
 - .2 If changes are required, notify Departmental Representative of these changes before they are made.

.3 Quality Control:

- .1 Provide CSA certified equipment and material.
- .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction inspection authorities for special approval before delivery to site.
- .3 Submit test results of installed electrical systems and instrumentation.
- .4 Permits and fees: in accordance with General Conditions of contract.
- .5 Submit, upon completion of Work, load balance report as described in PART 3 - Load Balance.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

1.5 QUALITY ASSURANCE

- .1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01.

1.6 SYSTEM STARTUP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - Submittals.
- .2 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and coordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit, wiring and connections below 50 V which are related to control systems and specified in mechanical sections and as shown on mechanical drawings.

2.3 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors.

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicoid, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled, voltage, phase, horsepower and circuit numbers.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.

2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.

2.6 CONDUIT AND CABLE IDENTIFICATION

- .1 Conduits should be marked as per use: "Power" or "Control".
- .2 Colour code conduits, boxes and metallic sheathed cables.
- .3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .4 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

2.8 FIRE-STOPPING

- .1 Fire-stop all pipe, duct, conduit, and wire penetrations through floors and walls designated as fire and/or smoke separations in accordance with Section 07 84 00 – Fire-Stopping.
- .2 Fire-stopping materials to meet ULC CAN 2S115.
- .3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per manufacturer's instructions.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.

- .2 Wall receptacles:
 - .1 In mechanical rooms: 1400 mm.
- .3 Panelboards: as required by Code or as indicated.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .4 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests and submit test report in presence Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

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

3.8 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 This Section specifies electrical requirements relating to the commissioning of electrical components and applies to all applicable sections in Division 26.
- .2 Related Sections:
 - .1 Section 01– General Commissioning (Cx) Requirements
- .3 Commissioning of building electrical components in affected renovation areas is of the utmost importance to ensure the successful operation of this building. Building renovations will not be considered complete until all components have been demonstrated to work precisely in accordance with the Contract requirements.
- .4 Responsibility for the satisfactory completion of the building and demonstration that the requirements of the commissioning are satisfied rests with the Contractor, who will employ and pay for any specialist supervision, inspection and testing as required to complete the work described.
- .5 The commissioning process consists of:
 - .1 Component verifications per this Section.
 - .2 Integrated Component Performance Verification Testing and Demonstration per Section 01.
- .6 Read this Section in conjunction with related Sections, which specify portions of electrical commissioning work. Refer also to Division 01.
- .7 Except where otherwise specified, arrange and pay for the testing and related requirements specified in this and related Sections.
- .8 If test results do not conform to applicable requirements, repair, replace or adjust components. Repeat testing as necessary until results acceptable to the Departmental Representative are achieved.

1.2 VERIFICATION AND REPORTING

- .1 General:
 - .1 Component Verification Testing shall be conducted per this Section.
 - .2 Submit completed verification and test reports immediately after inspections and/or tests are performed.
 - .3 Record all data gathered on site on approved verification forms with completed shop drawing data.

- .4 Provide the Departmental Representative with original of each completed verification form.
- .5 Maintain one (1) photocopy on site of all data taken during commissioning.
- .6 Maintain one copy of all final reports on site up to interim acceptance of the work for reference purposes.
- .7 All final verification forms are to be typewritten.
- .8 Submit to Departmental Representative for approval.
- .9 Make corrections and re-submit as requested by Departmental Representative.

1.3 SCHEDULE

- .1 Prior to starting and testing of components, prepare a schedule for the required testing.
- .2 Provide sufficient notice minimum ten (10) calendar days prior to commencing tests.
- .3 Departmental Representative may witness all or any portion of the component testing.
- .4 Contractor to be present for and participates in all tests.
- .5 Unless otherwise specified in writing by the Departmental Representative all testing and related requirements specified herein will be performed prior to the issue of the Interim Certificate of Completion.

1.4 COORDINATION

- .1 Coordinate all sub-trades, manufacturers, suppliers and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.
- .2 Where any components require testing prior to starting, ensure that such work has been completed and approved prior to starting of these components. In particular, the requirements specified in Division 26 shall be coordinated by the Contractor to complete the commissioning requirements

1.5 COMMISSIONING MEETINGS

- .1 Provide the appropriate representation at the scheduled commissioning meetings as outlined in Section 01.

1.6 PRESIDING AUTHORITIES

- .1 Starting procedures defined in this section may duplicate verification conducted by presiding authorities. To facilitate expedient turnover of the building, arrange for authorities to witness procedures in a manner that avoids unnecessary duplication of tests.
- .2 Obtain certificates of approval, acceptance and comply with rules and regulations of authorities having jurisdiction. Provide originals of all certificates to Departmental Representative.

1.7 CORRECTION OF DEFICIENCIES

- .1 Identify, record, resolve and correct all contract deficiencies found during commissioning.

1.8 COMPLIANCE WITH DEFINED PROCEDURES

- .1 Failure to follow the specific instructions defined herein pertaining to correct starting procedures may result in re-evaluation of components by independent testing agency selected by Departmental Representative at contractors expense. Should results reveal components have not been started in accordance with specified requirements, components may be rejected. If required, remove components from site and replace. Replacement components shall also be subject to full starting procedures. Using the same procedures specified on the originally installed components.

1.9 TESTING CONDUCTED BY DEPARTMENTAL REPRESENTATIVE

- .1 The Departmental Representative may select and conduct at random, components to be re-tested.
- .2 Testing of any component by the Departmental Representative does not reduce the Contractors obligations for complete testing and start-up of that component.
- .3 The Departmental Representative will be responsible for the direct costs of any Departmental Representative's testing excepting Contractor's support.
- .4 Contractor will provide, without cost, support for these tests.
- .5 Making all test equipment and instrumentation available to the Departmental Representative.
- .6 Operating appropriate components.
- .7 Any tests duplicated by the Departmental Representative will be conducted under the same terms of reference applied to the Contractor.
- .8 The Contractor can choose to witness any testing conducted by the Departmental Representative.

- .9 Should any component fail under Departmental Representative's testing the Contractor will correct the deficiency and re-test to the satisfaction of the Departmental Representative at the Contractor's expense.

1.10 SPECIALTY AGENT AND TESTING LABORATORIES

- .1 All reports generated by special testing agencies or testing laboratories shall be submitted by the Contractor to the Departmental Representative.
- .2 All agencies and testing laboratories shall be pre-approved by the Departmental Representative and have acceptable facilities and qualifications.

Part 2 Products

2.1 CONTRACTOR INSTRUMENTS TESTING

- .1 Provide two-way radios, ladders and other equipment as required to complete the program and as outlined in this Specification.
- .2 Provide all safety equipment required for personnel involved in the starting, testing, adjusting and balancing program.
- .3 Provide a list of equipment and instruments which will be used in starting, testing, and adjusting of electrical equipment for approval and review by the Departmental Representative.
- .4 Use instruments supplied or calibrated by approved laboratory or manufacturer. Show the Departmental Representative the current calibration certificate for each instrument to be used. Provide a copy of the calibration certificates with test reports

Part 3 Execution

3.1 GENERAL

- .1 Contractor and manufacturer startup and proving are to be carried out in accordance with the respective Section.

3.2 COMPONENT VERIFICATIONS

- .1 The component verification forms will be completed by the Contractor as follows:
- .1 The 'Specified' requirements shall be completed by the Contractor at the shop drawing submission stage.
- .2 The 'Shop Drawing' information shall be completed by the Contractor at the shop drawing submission stage.
- .3 The 'Installed' information shall be completed by the Contractor.

- .2 The component verification forms will be provided to the Contractor for information and convenience and will not relieve the Contractor of responsibility for verification of components not included on the verification forms.
- .3 A verification form is to be completed for each component requiring verification.
- .4 Component verification forms will be approved and subject to random verification by the Departmental Representative.

3.3 PERFORMANCE VERIFICATION TESTING

- .1 All Contractor and manufacturer startup and proving tests are to be completed and approved by the Departmental Representative prior to conducting the defined Performance Verification Tests.
- .2 All component verifications shall be completed by the Contractor and approved by the Departmental Representative prior to conducting the defined Performance Verification Test.
- .3 The Contractor will complete the Contractor verification portion of the Performance Verification Test form prior to notifying the Departmental Representative that the components are ready for verification.
- .4 Performance Verification Testing shall be Scheduled and conducted by the Contractor.
- .5 Performance Verification Tests as per the verification forms will be conducted in the presence of the Departmental Representative.

3.4 PERFORMANCE VERIFICATION TEST FORMS

- .1 Refer to Test Forms located in the Electrical Commissioning Forms (Section 26 05 10A).

END OF SECTION

MOULDED CASE CIRCUIT BREAKER COMMISSIONING FORM

Form E-1

Panel ID.: _____
Panel Location: _____
Voltage: _____

	BREAKER TYPE	BREAKER SIZE	BREAKER CURRENT TRIP SETTING (A)	INTERRUPTING CAPACITY (A)	PHASE	CORRECT CIRCUIT (✓)	LABELLED (Lamacoid or Typed Directory)	MEASURED LOAD (kW / kVA)	LOCK DOG (✓)
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									
Breaker #									

REMARKS

(Signature of Contractor)

(Name of Contracting Firm)

(Date)

(Signature of Consultant)

(Name of Consulting Firm)

(Date)

DISCONNECT SWITCH COMMISSIONING FORM

Form E-2

LOCATION	INDOOR / OUTDOOR	SIZE (A)	FUSED (YES/NO)	IDENTIFICATION LAMACOID (✓)	GENERAL CONDITION OF DISCONNECT ASSEMBLY (✓)	3 LOCK LOCKING ABILITY (✓)

REMARKS

(Signature of Contractor)

(Name of Contracting Firm)

(Date)

(Signature of Consultant)

(Name of Consulting Firm)

(Date)

INSULATION RESISTANCE COMMISSIONING FORM

Form E-3

Insulation Resistance (Megger) Test Voltages and Results for Circuits, Feeders and Electrical Equipment:

Maximum Voltage Rating of Equipment	Minimum dc Test Voltage	Minimum Acceptable Insulation Resistance	Recorded Insulation Resistance (MΩ)	Indicate Acceptance with a (✓) Mark

REMARKS

(Signature of Contractor)

(Name of Contracting Firm)

(Date)

(Signature of Consultant)

(Name of Consulting Firm)

(Date)

(Date)

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for wire and box connectors.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65-93(R1999), Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA).

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 NEMA to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded copper conductors bar.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.

- .4 Clamps or connectors for armoured cable, flexible conduit, as required to: CAN/CSA-C22.2No.18.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2 NEMA.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.

1.3 PRODUCT DATA

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .3 VFD cables: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RA90; 3 stranded tinned copper circuit conductors plus 3 symmetrical bare copper ground wires; 2 spiral copper tape shields providing 100% coverage. VFD cables shall be used between VFDs and pumps P-25 and P-26.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.

1.3 PRODUCT DATA

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .3 VFD cables: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RA90; 3 stranded tinned copper circuit conductors plus 3 symmetrical bare copper ground wires; 2 spiral copper tape shields providing 100% coverage. VFD cables shall be used between VFDs and pumps P-25 and P-26.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for connectors and terminations.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 65-03. Wire Connectors.
 - .2 CSA C22.2 No.41-M1987(R1999), Grounding and Bonding Equipment.

1.4 PRODUCT DATA

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

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper compression connectors to CSA C22.2 No.65-03 as required sized for conductors.

Part 3 Execution

3.1 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

- .7 For surface mounting of two or more conduits use channels at 3000 mm on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

Part 3 Execution

3.1 JUNCTION AND PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.2 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.1-2009, Canadian Electrical Code, Part 1.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

2.3 CONDUIT BOXES

- .1 Cast FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.4 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.5 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 56-1977(R1999), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83-M1985(R1999), Electrical Metallic Tubing.
 - .4 CSA C22.2 No. 211.2-M1984(R1999), Rigid PVC (Unplasticized) Conduit.
 - .5 CAN/CSA C22.2 No. 227.3-M91(R1999), Flexible Non-metallic Tubing.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic waste in designated containers.
- .2 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

Part 2 Products

2.1 CONDUITS

- .1 Rigid galvanized steel threaded conduit: to CSA C22.2 No. 45.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.
- .3 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, steel aluminum liquid-tight flexible metal.
- .5 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits NPS 2 50 mm. Two hole steel straps for conduits larger than NPS 2 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 3000mm oc.

- .4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90E bends are required for NPS 1 25 mm and larger conduits.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms in unfinished areas.
- .3 Surface mount conduits except as indicated on the drawing.
- .4 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.
- .5 Use rigid metal conduit where subject to mechanical injury.
- .6 Use rigid PVC conduit underground in corrosive areas.
- .7 Use flexible metal conduit for connection to motors in dry areas connection to recessed incandescent fixtures without a prewired outlet box connection to surface or recessed fluorescent fixtures work in movable metal partitions.
- .8 Minimum conduit size for lighting and power circuits: NPS 3/4 19 mm.
- .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 19 mm dia.

- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for non-fused disconnect switches.

1.2 RELATED SECTIONS

- .1 Section 01 – Submittal Procedures.
- .2 Section 01 – Governmental Safety Requirements.
- .3 Section 26 05 00 – Common Work Results - Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
 - .2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 - Submittal Procedures.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 – Governmental Safety Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Separate for reuse and recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No. 4 size as required.
- .2 Provision for padlocking in on-off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION