Part 1 General

1.1 SUBMITTALS

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

.2 Shop drawings; where required, submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.

.3 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.4 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.6 Closeout Submittals:

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance manual approved by, and final copies deposited with Contract Administrator before final inspection.
- .3 Operation data to include:
  - .1 Control schematics for systems including environmental controls.
  - .2 Description of systems and their controls.
  - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
  - .4 Operation instruction for systems and component.
  - .5 Description of actions to be taken in event of equipment failure.
  - .6 Valves schedule and flow diagram.
  - .7 Colour coding chart.
- .4 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.6 Approvals:

.1 Submit 1 copy of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless directed by Contract Administrator.

.2 Make changes as required and re-submit as directed by Contract Administrator.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Contract Administrator will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of Work. Mark changes as Work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show Work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Contract Administrator for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

1.3 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One gasket set for each heat exchanger.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

Part 2 Products (Not Used)

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

.1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 Heating, Ventilation and Air Conditioning (HVAC) Systems.

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular Work hours, prior to acceptance.

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

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

.6 Contract Administrator may record these demonstrations on video tape for future reference.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 Canadian Standards Association (CSA International)

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

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.

.4 National Fire Code of Canada (NFCC 2005)

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.1 Primers, paints and coatings: in accordance with manufacturer's recommendations for surface conditions.

Part 3 Execution

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

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

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain.

.1 Discharge to be visible.

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

3.5 AIR VENTS

.1 Install automatic air vents to 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.

3.6 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

.1 Install pipework to CSA B149.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ANSI standards.

.6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.8 Install concealed pipework to minimize furring space, maximize headroom, and conserve space.

.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.10 Install, except where indicated, to permit separate thermal insulation of each pipe.

.11 Group piping wherever possible and as indicated.

.12 Ream pipes, remove scale and other foreign material before assembly.

.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.14 Provide for thermal expansion as indicated.

.15 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.16 Check Valves:

.1 Install silent check valves on discharge of pumps.

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for firestopping.

.2 Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.

.1 Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: outside diameter to cover opening or sleeve.

.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning Work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Contract Administrator.

.6 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

.7 Insulate or conceal Work only after approval and certification of tests by Contract Administrator.

3.13 EXISTING SYSTEMS

.1 Connect into existing piping systems as indicated.

.2 Be responsible for damage to existing plant by this Work.

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 Division 23. Refer to Division 26 for quality of materials and workmanship.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

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

.2 Product Data:

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

.3 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle 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.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

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

2.4 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 Correct size of sheave determined during commissioning.

.5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.6 Motor slide rail adjustment plates to allow for centre line adjustment.

.7 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm thick sheet metal tops and bottoms.

.3 38 mm dia. holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.-

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A105/A105M-05, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

.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.

1.3 CLOSEOUT SUBMITTALS

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

.1 Data to include:

.1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 FLEXIBLE CONNECTION

.1 Application: to suit motion as indicated.

.2 Minimum length in accordance with manufacturer's recommendations to suit offset as indicated.

.3 Inner hose: stainless steel corrugated.

.4 Braided wire mesh stainless steel outer jacket.

.5 Diameter and type of end connection: to match associated piping.

.6 Operating conditions:

.1 Working pressure: 1034 kPa.

.2 Working temperature: from -40 °C to 107°C (-40 °F to 225°F)

.3 To match system requirements.

2.2 ANCHORS AND GUIDES

.1 Anchors:

.1 Provide as indicated.

.2 Alignment guides:

.1 Provide as indicated.

.2 To accommodate specified thickness of insulation.

.3 Vapour barriers, jackets to remain uninterrupted.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install expansion joints with cold setting. Make record of cold settings.

.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

.4 Do welding in accordance with section 23 05 17- Pipe Welding.

3.3 PIPE CLEANING AND START-UP

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

3.4 PERFORMANCE VERIFICATION

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

3.5 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ANSI/ASME B31.1-2007, Power Piping.

.2 ANSI/ASME B31.3-2006, Process Piping.

.3 ANSI/ASME Boiler and Pressure Vessel Code-2007:

.1 BPVC 2007 Section I: Power Boilers.

.2 BPVC 2007 Section V: Nondestructive Examination.

.3 BPVC 2007 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

.1 AWS C1.1M/C1.1-2000(R2006), Recommended Practices for Resistance Welding.

.2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.

.3 AWS W1-2000, Welding Inspection Handbook.

.4 Canadian Standards Association (CSA International)

.1 CSA W47.2-M1987(R2008), Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1-2008, Certification of Welding Inspection Organizations.

.6 CSA W178.2-2008, Certification of Welding Inspectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Welders:

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Submit welder's qualifications to Contract Administrator.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:

.1 Inspectors qualified to CSA W178.2.

.3 Certifications:

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 APPLICATION

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

3.2 QUALITY OF WORK

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

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Contract Administrator before Work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Contract Administrator.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

.1 General:

.1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Contract Administrator.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests.

.2 Hydrostatically test welds to ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by Contract Administrator. Perform testing of up to 10 % of welds by particle test. Welds shall be selected at random by Contract Administrator.

3.6 DEFECTS CAUSING REJECTION

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

3.7 REPAIR OF WELDS WHICH FAILED TESTS

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

3.8 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008, 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

.2 Ranges: 0-1100 kPa.

2.2 DIRECT READING THERMOMETERS

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

.1 Resistance to shock and vibration.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 PRESSURE GAUGES

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

.2 Provide:

.1 Snubber for pulsating operation.

.2 Diaphragm assembly for corrosive service.

.3 Gasketted pressure relief back with solid front.

.4 Bronze stop cock.

Part 3 Execution

3.1 GENERAL

.1 Install thermometers and gauges so they can be easily read from floor or platform.

.1 If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on piping. Include heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Heat exchangers.
.2 Water boilers.

.3 Install wells for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in locations as follows:

.1 Suction and discharge of pumps.
.2 Upstream and downstream of PRV's.
.3 Inlet and outlet of liquid side of heat exchangers.
.4 Outlet of boilers.
.5 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates identifying medium.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals.

.3 Mechanical drawings.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-07, Power Piping.

.2 ASTM International

.1 ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat Treated.

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

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

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

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

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS 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.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated.

.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: 13 mm FM approved.

.2 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.

.2 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.

.5 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.6 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.7 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for riveting to insulation shields.

.8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.9 U-bolts: carbon steel to MSS SP69 with two nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.

.10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS SP58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 164 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 300 and over, carbon steel to comply with MSS SP69.

2.6 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.

2.7 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with two 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.

2.8 EQUIPMENT SUPPORTS

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

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
.2 Bolt-tightening torques to industry standards.
.3 Steel pipes: install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 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.

.7 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 Canadian Plumbing Code and authority having jurisdiction.

.2 Copper piping: up to NPS 1/2: every 1.5 m.

.3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.4 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 32	2.4 m	1.8 m
38	3.0 m	2.4 m
50	3.0 m	2.4 m
63	3.7 m	3.0 m
75	3.7 m	3.0 m
89	3.7 m	3.3 m
100	3.7 m	3.6 m
125	4.3 m	
150	4.3 m	
200	4.3 m	
250	4.9 m	
300	4.9 m	

.5 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

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

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

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

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

3.7 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of new equipment, piping systems, ductwork, valves and controllers, including the installation and location of identification systems.

.2 Related Sections:

.1 01 33 00 - Submittal Procedures

.2 01 74 11 - Cleaning.

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

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

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

1.3 SUBMITTALS

.1 Product Data:

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

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

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

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

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

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

.4 Locations:

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

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

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 N/A

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1.

.2 Propane gas: to CSA/CGA B149.1.

.3 Sprinklers: to NFPA 13.

.4 Standpipe and hose systems: to NFPA 14.

2.5 IDENTIFICATION OF PIPING SYSTEMS

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

.2 Pictograms:

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

.3 Legend:

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

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Contract Administrator.

.2 Colours for legends, arrows: to following table:

Background colour:	**Legend, arrows:**
Yellow	BLACK
White	BLACK

.3 Background colour marking and legends for piping systems:

Contents	**Background colour marking**	**Legend**
** Add design temperature		
++ Add design temperature and pressure		
Hot Water Heating Supply	White	HWS
Hot Water Heating Return	White	HWR
Glycol Heating Supply	White	GHS
Glycol Heating Return	White	GHR
Natural Gas	Yellow (Paint entire pipe according to codes)	

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 EQUIPMENT

.1 Identify all equipment with specified tags as indicated on drawings.

2.10 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 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.

3.3 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

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

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.6 CLEANING

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

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

END OF SECTION

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 SCOPE OF WORK

.1 TAB of new circulation pumps (P-1A, P-1B, P-3A, P-3B).

.2 TAB of new Air Handling Units (AHU-1 and AHU-2).

.1 Scope of Work includes:

.1 Balancing glycol flow rates to each associated heating coil.

.2 Balancing the outdoor air and exhaust rates at each air handling unit and setting appropriate damper positions. The air handling units shall be balanced to maintain a negative pressure of -0.05 to -0.15 in.w.c. within the lap pool area. (Air handling systems of the main pool must also be operational when measuring negative pressure as the two pools are interconnected.)

.3 Balancing all associated supply and return air grilles.

.3 TAB of hot water flow to new Heat Exchangers (HX-1A and HX-1B).

.4 TAB of existing vestibule heating systems tied into new glycol loop.

.5 Coordinate Work with all applicable sections including section 230933 Electric and Electronic Control for HVAC

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Contract Administrator within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist. 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.

1.4 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.

1.5 EXCEPTIONS

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

1.6 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Contract Administrator in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 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.

1.9 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Contract Administrator for verification of TAB reports.

1.10 START OF TAB

.1 Notify Contract Administrator 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.
.2 Duct systems clean.
.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
.4 Correct fan rotation.
.5 Fire, smoke, volume control dampers installed and open.
.6 Coil fins combed, clean.
.7 Access doors, installed, closed.
.8 Outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.
.2 Correct pump rotation.
.3 Strainers in place, baskets clean.
.4 Isolating and balancing valves installed, open.
.5 Calibrated balancing valves installed, at factory settings.
.6 Chemical treatment systems complete, operational.

1.11 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5 %, minus 5%.
.2 Hydronic systems: plus or minus 10 %.

1.12 ACCURACY TOLERANCES

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

1.13 INSTRUMENTS

.1 Prior to TAB, submit to Contract Administrator list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Contract Administrator.

1.14 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Contract Administrator, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.

1.16 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 one copies of TAB Report to Contract Administrator for verification and approval, in English in electronic (PDF) format.

1.17 VERIFICATION

.1 Reported results subject to verification by Contract Administrator.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Contract Administrator.

.4 Pay costs to repeat TAB as required to satisfaction of Contract Administrator.

1.18 SETTINGS

.1 After TAB is completed to satisfaction of Contract Administrator, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.19 COMPLETION OF TAB

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

1.20 AIR SYSTEMS

.1 Standard: TAB to most stringent of TAB standards of AABC.

Do TAB of systems, equipment, components, controls specified Division 23.

.2 Qualifications: personnel performing TAB current member in good standing of AABC.

.3 Quality assurance: perform TAB under direction of supervisor qualified by AABC.

.4 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.5 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.21 OTHER TAB REQUIREMENTS

.1 General requirements applicable to Work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

.2 Smoke management systems:

.1 Test for proper operation of all smoke and fire dampers, sensors, detectors installed as component parts of air systems specified Division 23.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 01 33 00 - Submittal Procedures

.2 01 74 11 – Cleaning

.3 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

.1 Definitions:

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previously defined.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

.2 Reference Standards:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Description of equipment giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.3 Manufacturers' Instructions:

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

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: specialist in performing Work of this section, and have at least 3 years successful experience in this size and type of project.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.3 Aluminum (to be used on all outdoor ductwork):

.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: corrugated.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:

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

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.

.7 Contact adhesive: quick-setting

.8 Canvas adhesive: washable.

.9 Tie wire: 1.5 mm stainless steel.

.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.11 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 APPLICATION

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

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular and round ducts outside	C-1	yes	50

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

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

.1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4

3.5 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Insulation of all new and modified hydronic (water and glycol) piping, valves, strainers, etc.

.2 Related Sections:

.1 01 33 00 - Submittal Procedures

.2 01 74 11 - Cleaning.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1-01, 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 C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-04, 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 C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-2003, 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) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

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

.1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 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-S702-1997, 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 ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

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

.2 Product Data:

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

.3 Shop Drawings:

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

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

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

.2 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.2 Installer: specialist in performing Work of this Section, and have at least 3 years successful experience in this size and type of project.

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 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.
.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.6 TIAC Code A-6: flexible unicellular tubular elastomer.

.1 Insulation: with vapour retarder jacket.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.
.4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: to ASTM C533.
.2 Maximum "k" factor: to CAN/ULC-S702.
.3 Design to permit periodic removal and re-installation.

2.3 BURRIED AND OUTDOOR PIPING

.1 Foam glass rigid insulation, lightweight, completely sealed glass cells, all-glass, closed-cell structure, zero water vapor permeability, moisture resistant, corrosion resistant, lng-term dimensional stability, CFC and HCFC Free, ASTM C 552 Specification for Cellular Glass Thermal Insulation. -268°C to +482°C operating temperature range. Install per manufacturer's instructions.

2.4 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.5 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting on mineral wool, to ASTM C449/C449M.

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.9 JACKETS

.1 **Indoor**: Polyvinyl Chloride (PVC):

.1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.
.2 Colours: to match adjacent finish paint.
.3 Minimum service temperatures: -20 degrees C.
.4 Maximum service temperature: 65 degrees C.
.5 Moisture vapour transmission: 0.02 perm.
.6 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.

.2 Buried: Continuously sealed blue skin self-adhesive membrane, fully water/frost resistant bring up minimum 600mm above grade. Exposed portions above grade to be jacketed over with indoor (PVC) or outdoor (Aluminum) jacket.

.3 **Outdoor:** Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: stucco embossed.

.4 Joining: longitudinal and circumferential slip joints with 50mm laps.

.5 Fittings: 0.5mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19mm wide, 0.5mm thick at 300mm 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 manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, 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: PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

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

.2 Thickness of insulation as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Hot Water Heating	60 - 94	A-1	25	38	38	38	38	38
Hot Water Heating	up to 59	A-1	25	25	25	25	38	38
Domestic HWS		A-1	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25

.3 Finishes:

.1 Exposed indoors: canvas jacket.

.2 Exposed in mechanical rooms: canvas.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Outdoors: water-proof aluminum jacket.

.6 Finish attachments: SS bands, at 150 mm on centre.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 01 91 13 - General Commissioning (Cx) Requirements
.2 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems

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 48 hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

.1 Pump operation.
.2 Boiler operation.
.3 Control pressure failure.
.4 Maximum heating demand.
.5 Boiler failure.
.6 Outdoor reset. Re-check boiler 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.

.6 Heating system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or

.2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.

.2 Test procedures:

.1 Open fully 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.

1.6 REPORTS

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

1.7 TRAINING

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning mechanical piping systems.

.2 Related Sections:

.1 01 33 00 - Submittal Procedures

.2 01 74 11 - Cleaning

.3 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCES

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

.1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

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

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions.

Part 2 Products

2.1 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 CLEANING HYDRONIC SYSTEMS

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
.1 Cleaning procedures, flow rates, elapsed time.
.2 Chemicals and concentrations used.
.3 Inhibitors and concentrations.
.4 Specific requirements for completion of Work.
.5 Special precautions for protecting piping system materials and components.
.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

.3 Use water metre to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to maximum design. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.7 Repeat with water at design temperature.

.8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.9 Bring system up to design temperature and pressure slowly over a 48 hour period.

.10 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.11 Adjust pipe supports, hangers, springs as necessary.

.12 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.13 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.14 Check operation of drain valves.

.15 Adjust valve stem packing's as systems settle down.

.16 Prior to start of TAB, fully open balancing valves (except those that are factory-set).

.17 Check operation of over-temperature protection devices on circulating pumps.

.18 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

.1 Air Handling Units (AHU-1 and AHU-2)

.1 Provide system of controls as per sequence of operations stated herein. Provide heating/cooling changeover based on outdoor air temperature.

.1 Occupied Mode

.1 Supply and Return Air fans runs continuously.

.2 Mixing Dampers open to allow 6,600 CFM outside air.

.3 Modulate three-way mixing control valve associated with outside air pre-heating coil to maintain 68°F discharge air to the main heating coil (set point to be operator adjustable).

.4 Modulate three-way mixing control valve associated with main heating coil to maintain heating mode supply air temperature setpoint. (Do not modulate dampers when in heating mode.)

.5 Supply air temperature setpoint shall be reset to maintain pool heating mode space temperature setpoint as required.

.6 When in cooling mode, modulate dampers to provide free cooling to maintain summer space temperature set point where outdoor conditions permit.

.2 Unoccupied Mode

.1 Supply and Return Air Blower runs continuously.

.2 Mixing Dampers set to full return air.

.3 On call for dehumidification during unoccupied period, mixing dampers shall open to allow 6,600 CFM outside air.

.4 When dehumidification is satisfied, mixing dampers shall return to full return air setting.

.5 Modulate three-way mixing control valve associated with main heating coil to maintain supply air temperature setpoint.

.6 Supply air temperature setpoint shall be reset to satisfy room setpoint requirements.

.3 DDC shall monitor the following:

.1 Supply and Return Fan Status.

.2 Outdoor air temperature.

.3 Mixed air temperature.

.4 Supply air temperature.

.5 Damper positions.

.6 Control Valve positions.

.7 Air filters differential pressure.

.8 Pool space temperature and relative humidity level.

.4 DDC shall alarm the following:

.1 Supply and Return Fan failures

.2 Damper Actuator failures.

.3 Control Valve failures.

.4 Low supply air temperature (Freezestat by Section 237311).

.5 High air filter differential pressure (Clogged filter).

.5 Control Valves: Supplied by Section 23 09 33 / Installed by Section 23 21 13.02

.6 Damper Actuators: Supplied/Installed by Section 23 09 33. Co-ordinate with Section 23 73 11).

.2 Glycol Circulation Pumps (P-1A and P-1B):

.1 DDC System shall operate the pumps as follows:

.1 One pump shall operate continuously.

.2 Second pump to remain stand-by.

.3 Provide start / stop / status of both pumps.

.4 Upon pump failure, DDC system shall automatically start stand-by pump and generate a pump failure alarm for the failed pump.

.5 DDC system shall provide duty cycling of the pumps based on run time.

.3 Hydronic Circulation Pumps (P-3A and P-3B):

.1 DDC System shall operate the pumps as follows:

.1 One pump shall operate continuously.

.2 Second pump to remain stand-by.

.3 Provide start / stop / status of both pumps.

.4 Upon pump failure, DDC system shall automatically start stand-by pump and generate a pump failure alarm for the failed pump.

.5 DDC system shall provide duty cycling of the pumps based on run time.

.4 Heat Exchangers (HX-1A and HX-1B):

.1 DDC shall monitor the following:

.1 Glycol loop supply and return temperatures.

.2 Hot water supply and return temperatures.

.2 DDC system shall alarm the following:

.1 Low glycol loop supply water temperatures.

.5 There is an existing central monitoring system in place. All DDC points are identified as centrally monitored points. The Contractor shall provide and install required hardware and software to interface to the existing Johnson Controls Metasys EA servers and workstations. These are located at the Central Control Offices, 510 Main Street, Winnipeg, Manitoba. All new controls shall be provided by the manufacturer of the existing control system. The Contractor is required to meet with the City for additional direction.

.6 Contractor to supply all drawings/graphics/sequence of operations in both a hard and soft copy. Drawings and graphics to be able to be read and modified by The City. User interface graphics to be completed using Graphic Generation Tool software. Graphics must use The City of Winnipeg graphic templates. Contractor to supply As-Built drawings in an editable format, able to be easily edited by The City.

.7 BACnet Communication protocol shall be provided. All control panels shall be located within the basement mechanical rooms.

.8 A complete list of setpoints for all controlled equipment shall be provided.

.9 A points list is to be provided for all controlled objects

.10 Alarm Messages: All objects that must be alarmed will have in the alarm message text the following information as per the included example. Alarm Message: Building Address, What is in alarm, see graphic for Instruction. Example: 251 Donald SF-1 VFD Common Alarm, see graphic for Instruction.

1.2 REFERENCES

.1 ANSI/ASHRAE STANDARD 135-2010 BACnet—A Data Communication Protocol for Building Automation and Control Networks

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop drawings and Product Data:

.1 Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.

.2 Submit manufacturer's instructions, printed product literature and data sheets for electric and electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.

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

.4 Shop Drawings, Product Data, and Samples

.1 The BMS Subcontractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.

.2 Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Contract Administrator for Contract compliance.

.3 Allow 15 working days for the review of each package by the Contract Administrator in the scheduling of the total BMS Work.

.4 Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Subcontractor where filing is necessary. Provide a copy of all related correspondence and permits to the Contract Administrator.

.5 Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.

.1 The BMS Subcontractor shall correct any errors or omissions noted in the first review.

.2 At a minimum, submit the following:

.1 BMS network architecture diagrams including all nodes and interconnections.

.2 Systems schematics, sequences and flow diagrams.

.3 Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.

.4 Samples of Graphic Display screen types and associated menus.

.5 Detailed Bill of Material list for each system

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to Site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect electric and electronic control systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 POWER SUPPLIES AND LINE FILTERING

.1 Control transformers shall be CSA approved. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with CEC requirements. Limit connected loads to 80% of rated capacity.

2.2 FLOW SWITCHES

.1 Flow-proving switches shall be either paddle or differential pressure type, as shown.

.2 Differential pressure type switches (air or water service) shall be CSA approved, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as specified.

2.3 RELAYS

.1 Control relays shall be CSA approved plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

.2 Time delay relays shall be CSA approved solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

2.4 LOCAL CONTROL PANELS

.1 All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.

.2 Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be CSA approved for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

.3 Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.5 WIRING AND CONDUITS

.1 General: Provide copper wiring and conduits as specified in the applicable sections of Division 26.

.2 All wiring shall be run in conduits.

.3 All insulated wire to be copper conductors, UL labeled for 90°C minimum service.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for electric and electronic control systems installation in accordance with manufacturer's written instructions.

3.2 GENERAL WORKMANSHIP

.1 Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

.2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

.3 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

.4 All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.3 WIRING

.1 All control and interlock wiring shall comply with the CEC and local electrical codes and Division 26 of this specification. Where the requirements of this section differ from those in Division 26, the requirements of this section shall take precedence.

.2 All CSA Class 1 (line voltage) wiring shall be CSA approved in approved raceway according to CSA and Division 26 requirements.

.3 All low-voltage wiring shall meet CSA Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)

.4 Where CSA Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are CSA approved for the intended application. For example, cables used in ceiling plenums shall be CSA approved specifically for that purpose.

.5 All wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage shall be installed in raceway at levels below 3 m (10 ft).

.6 Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

.7 Do not install wiring in raceway containing tubing.

.8 Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and *neatly* tied at 3 m (10 ft) intervals.

.9 Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

.10 All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

.11 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

.12 Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the BMS Subcontractor shall provide step-down transformers.

.13 All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

.14 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

.15 Size of raceway and size and type of wire shall be the responsibility of the BMS Subcontractor, in keeping with the manufacturer's recommendations and CSA requirements, except as noted elsewhere.

.16 Include one pull string in each raceway 2.5 cm (1 in.) or larger.

.17 Use coded conductors throughout with conductors of different colors.

.18 Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

.19 Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).

.20 Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

.21 Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.

.22 Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

.23 The BMS Subcontractor shall terminate all control and/or interlock wiring and shall maintain updated (asbuilt) wiring diagrams with terminations identified at the job Site.

.24 Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.

.25 Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for piping, valves and fittings for gas fired equipment.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.

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

.4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.

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

.1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B75M-99, Standard Specification for Seamless Copper Tube [Metric].

.4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)

.1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.

.2 CAN/CSA B149.2-00, Propane Storage and Handling Code.

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

.1 Material Safety Data Sheets (MSDS).

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:

.1 NPS 1/2 to 2, screwed.

.2 NPS 2 1/2 and over, plain end.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.

.2 Steel pipe flanges and flanged fittings: to ASME B16.5.

.3 Welding: butt-welding fittings.

.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

.5 Bolts and nuts: to ASME B18.2.1.

.6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: to ASME B16.18.

.2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated ball type.

2.5 IDENTIFICATION

.1 Painted yellow per section 23 05 53.01.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

.1 Install in accordance with Section 23 05 01 - Installation of Pipework, CAN/CSA B149.1, and authority having jurisdiction.

.2 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Contract Administrator.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.

3.5 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1

.2 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Materials and installation for steel piping, valves and fittings for hydronic systems.

.2 Delivery lead time of material specified herein shall not exceed 4 weeks.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 23 05 17 - Pipe Welding.

.4 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

.5 Section 23 05 05 - Installation of Pipework.

.6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.7 Section 23 08 01 - Performance Verification of Mechanical Piping.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASME B16.3-98, Malleable Iron Threaded Fittings.

.3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).

.6 ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).

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

.1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536-84(1999)e1, Standard Specification for Ductile Iron Castings.

.4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.

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

.6 ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).

.1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-025, Butterfly Valves.
.2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
.3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
.4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
.5 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.4 SUBMITTALS

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

.2 Closeout Submittals.

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

1.5 MAINTENANCE

.1 Extra Materials.

.1 Provide following spare parts:
.1 Valve seats: one for every ten valves, each size. Minimum one.
.2 Discs: one for every ten valves, each size. Minimum one.
.3 Stem packing: one for every ten valves, each size. Minimum one.
.4 Valve handles: two of each size.
.5 Gaskets for flanges: one for every ten flanges.

Part 2 Products

2.1 PIPE

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

.1 To NPS 12: Schedule 40.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with Teflon tape.
.2 NPS 2 1/2 and over: welding fittings and flanges to CSAW47.1 and CSA W47.1S1.
.3 Flanges: raised face, weld neck.
.4 Flange gaskets: to ANSI/AWWA C111/A21.11.
.5 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
.6 Pipe thread: taper.

2.3 FITTINGS

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

.2 Pipe flanges and flanged fittings:
.1 Steel: to ANSI/ASME B16.5.

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

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

2.4 VALVES

.1 Connections:

.1 NPS 2 and smaller: screwed ends.

.2 NPS 2 ½ and larger: Flanged ends.

(Grooved connections not permitted)

.2 Ball Valves:

.1 NPS 2 and under:

.1 To ASTM B62, 4 MPa WOG, bronze body, screwed ends, TFE seal, hard chrome solid ball, Teflon seats and lever handle.

.2 Acceptable product: Toyo Figure 5044A, Crane, Grinnell or approved equivalent in accordance with B7.

.3 Gate valves:

.1 NPS 2 and under:

.1 Rising stem: to MSS SP-80, Class 125, 860 kPa, bronze body, solid wedge disc.

.2 Acceptable material: Toyo Fig 206A, Crane, Grinnell or approved equivalent in accordance with B7.

.2 NPS 2 ½ and over:

.1 Rising stem, OS & Y, bolted bonnet, solid wedge, disc flanged end, to MSS SP-70, cast iron body bronze trim.

.2 Acceptable material: Toyo Fig No. 421A, Crane, Grinnell or approved equivalent in accordance with B7.

.4 Balancing Valves:

.1 NPS 2 ½ and over:

.1 flanged cast iron body construction, c/w memory stop, and differential pressure readout ports.

.2 Acceptable Product: “Armstrong” Model: CBV-FS or approved equivalent in accordance with B7.

.5 Check Valves:

.1 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 Standard specification: MSS SP-80.

.6 Control Valves: Supplied by Section 23 09 33 / Installed by Section 23 21 13.02.

Part 3 Execution

3.1 PIPING INSTALLATION

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

3.2 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND START-UP

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

3.4 TESTING

.1 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.5 BALANCING

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

3.6 GLYCOL CHARGING

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

3.7 PERFORMANCE VERIFICATION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME-04(2007), Boiler and Pressure Vessel Code.

.2 ASTM International Inc.

.1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84(2004), Standard Specification for Ductile Iron Castings.

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

.3 Canadian Standards Association (CSA International)

.1 CSA B51-03(R2003), Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA B51-03(R2005), Boiler, Pressure Vessel, and Pressure Piping Code, Supplement #1.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 EXPANSION TANK (EXP-1)

.1 Tank volume: 130 L (34 gal), acceptance volume: 100 L (27 gal), 508 mm (20 inch) diameter, 881 mm (34-11/16 inch) height. Weight: 59 kg (130 lb).

.2 Pre-charged steel expansion tank with replaceable heavy duty butyl rubber bladder. 115°C (240°F) design temperature, with 862 kPa (125 PSI) working pressure. Tank shall have a 25 mm NPT system connection, 19 mm NPT drain, and a charging valve connection. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and stamped 862 kPa (125 PSI) working pressure.

.3 Acceptable Product: “Bell & Gossett” model B-130LA or approved equivalent according to B7.

2.2 AIR VENTS

.1 Automatic air vent suitable for hot water heating system with brass body and high temperature resistant polyethylene float.

.2 Acceptable Product: “Watts” model FV-4M1 or approved equivalent according to B7.

2.3 AIR SEPARATOR

.1 100 mm (4”) Flanged inlet and outlet connections, Diameter: 218 mm (8.6”), Height: 602 mm (23.7”), Dry Weight: 48.6 kg (107 lb), steel shell, brass skim valve, brass/non-ferrous air vent.

.2 Coalescing type air eliminator for hot water systems. Rated for 1034 kPa (150 PSI) working pressure, and stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels. The elements shall consist of a copper core tube with continuous wound copper wire medium. Separate venting chamber to prevent system contaminants from harming the float actuated brass venting system. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

.3 Acceptable Product: “Spirotherm” model VSR400 or approved equivalent according to B7.

2.4 STRAINER

.1 1/2 NPS to 2 NPS: bronze body to ASTM B62, screwed connections, Y pattern.

.2 2-1/2 NPS to 12 NPS: cast steel body to ASTM A278/A278M, Class 30, flanged connections.

Part 3 Execution

3.1 APPLICATION

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

3.2 GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Contract Administrator’s directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.3 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve larger than NPS 25 and as indicated.

3.4 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.5 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

3.6 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC)

.3 Canadian Standards Association (CSA International)

.1 CSA-B214-07, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturers' Association (NEMA)

.1 NEMA MG 1-2006, Motors and Generators.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for pump, circulator, and equipment, and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE

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

Part 2 Products

2.1 GLYCOL CIRCULATION PUMPS (P-1A AND P-1B)

.1 Capacity: 11.1 L/s (176 usgpm) against total differential head of 300 kPa (100 ft. of Head.), 7.09 BHP at design.

.2 Fluid: 50% Propylene Glycol

.3 Impeller: 266 mm (10.5”)

.4 Connections: 75 mm (3") Flanged, flange to flange distance 610 mm (24”).

.5 Construction:

.1 Close coupled vertical inline centrifugal pump.

.2 Pump casing shall be constructed of ASTM A48 class 30 cast iron with ANSI 125 / PN16 flanges. Maximum working pressure 12 bar (175 psig), maximum working

temperature at 107°C (225°F). The casing shall be hydrostatically tested to 150% maximum working pressure. The casing shall be radially split to allow removal of the rotating element without disturbing the pipe connections.

.3 Pump impeller shall be fully enclosed type. The impeller shall be keyed and secured to the pump shaft by stainless steel fittings.

.4 The pump shaft shall be a stainless steel stub shaft for frame 56 motors. The steel motor shaft shall be enclosed by a bronze shaft sleeve, on other motor frame sizes.

.5 Mechanical Seal shall be single spring inside type with Carbon and Ceramic faces, EPDM elastomer, stainless steel spring and hardware. Provide factory installed seal vent line, piped from the seal area to the pump suction connection.

.6 Motor: 11.1 kW (15 HP), 575/3/60, 1800 RPM, ODP with NEMA Premium Efficiency rating, motor shall be non-overloading at any point on the impellor curve.

.7 Weight: 220 kg (485 lb).

.8 Acceptable product: “Bell & Gossett” 3x3x11B Series e-80SC c/w suction diffusers and triple duty valves or approved equivalent in accordance with B7.

2.2 HYDRONIC CIRCULATION PUMPS (P-3A AND P-3B)

.1 Capacity: 19.24 L/s (305 usgpm) against total differential head of 215 kPa (72 ft. W.C.), 1.33 BHP at design.

.2 Fluid: Water

.3 Impeller: 235 mm (9.25”)

.4 Connections: 75 mm (3") Flanged, flange to flange distance 584 mm (23”).

.5 Construction:

.1 Close coupled vertical inline centrifugal pump.

.2 Pump casing shall be constructed of ASTM A48 class 30 cast iron with ANSI 125 / PN16 flanges. Maximum working pressure 12 bar (175 psig), maximum working temperature at 107°C (225°F). The casing shall be hydrostatically tested to 150% maximum working pressure. The casing shall be radially split to allow removal of the rotating element without disturbing the pipe connections.

.3 Pump impeller shall be fully enclosed type. The impeller shall be keyed and secured to the pump shaft by stainless steel fittings.

.4 The pump shaft shall be a stainless steel stub shaft for frame 56 motors. The steel motor shaft shall be enclosed by a bronze shaft sleeve, on other motor frame sizes.

.5 Mechanical Seal shall be single spring inside type with Carbon and Ceramic faces, EPDM elastomer, stainless steel spring and hardware. Provide factory installed seal vent line, piped from the seal area to the pump suction connection.

.6 Motor: 0.74 kW (10 HP), 575/3/60, 1800 RPM, ODP, motor shall be non-overloading at any point on the impellor curve.

.7 Weight: 197.7 kg (435 lb).

.8 Acceptable product: “Bell and Gossett” Series e-80SC 3x3x9.5C or approved equivalent in accordance with B7.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install hydronic pumps to: CSA-B214.

.2 Provide pipe modifications and new flanges as required to match pump. Replace pipe insulation as required.

.3 In line circulators: install as indicated by flow arrows.

.1 Support at inlet and outlet flanges or unions.

.2 Install with bearing lubrication points accessible.

.4 Base mounted type: supply templates for anchor bolt placement.

.1 Include anchor bolts with sleeves. Place level, shim unit and grout.

.2 Align coupling in accordance with manufacturer's recommended tolerance.

.5 Ensure that pump body does not support piping or equipment.

.1 Provide stanchions or hangers for this purpose.

.2 Refer to manufacturer's installation instructions for details.

.6 Install volute venting pet cock in accessible location.

.7 Check rotation prior to start-up.

.8 Install pressure gauge test cocks.

3.3 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements; supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours minimum.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.2 ASTM International

.1 ASTM A653/A653M-09b, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).

.3 Green Seal Environmental Standards (GS)

.1 GS-36-11, Standard for Adhesives for Commercial Use.

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

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

.3 SMACNA IAQ Guideline for Occupied Buildings Under Construction, 2007.

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Test and Evaluation Reports:

.1 Certification of Ratings:

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

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials in dry location, off ground, and in accordance with manufacturer's recommendations.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DUCTWORK

.1 Ductwork shall be constructed to maximum static pressure that the associated fans can produce.

.2 Material:

.1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.

.2 Thickness: to SMACNA.

.3 Construction: round.

.1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.

.2 Transverse joints up to 900 mm: slip type with tape and sealants.

.3 Transverse joints over 900 mm: Vanstone.

.4 Fittings:

.1 Elbows: smooth radius. Centreline radius: 1.5 times diameter.

.2 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.

.4 Construction: rectangular:

.1 Ducts: to SMACNA.

.2 Transverse joints: SMACNA seal Class A and B.

.3 Fittings:

.1 Elbows: smooth radius; centreline radius 1.5 times width of duct. No vanes.

.2 Branches: with conical branch at 45 degrees and 45 degrees elbow.

.5 Fire stopping:

.1 50 x 50 x 3 mm retaining angles around duct, on both sides of fire separation.

.2 Fire stopping material must not distort duct.

2.2 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure (Pa)	SMACNA Seal Class
2500	A
1500	A
1000	A
750	B

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.3 SEALANT

.1 Oil resistant, water-borne polymer type flame resistant high velocity duct sealing compound.

.1 Temperature range of minus 40 degrees C to plus 93 degrees C.

2.4 TAPE

.1 Tape: polyvinyl treated, open weave fibre glass, 50 mm wide.

2.5 HANGERS AND SUPPORTS

.1 Hangers and supports: in accordance with Section 23 05 29- Hangers and Supports for HVAC Piping Equipment.

.1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.

.2 Trapeze hangers: ducts over 500 mm diameter or longest side, to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA and following table:

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

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

3.2 HANGERS

.1 Band hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

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

3.3 SEALING AND TAPING

.1 Apply sealant in accordance with manufacturer's recommendations and SMACNA.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.4 LEAKAGE TESTS

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

.2 Perform leakage tests in sections.

.3 Perform trial leakage tests, as instructed to demonstrate quality of Work.

.4 Do not install additional ductwork until trial tests have been passed.

.5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.6 Complete tests before performing insulation or concealment Work.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

.2 Related Sections:

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

1.2 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

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

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

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

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

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

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's Field Reports: manufacturer's field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

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

2.2 FLEXIBLE CONNECTIONS

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

.2 Material:

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

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks.
.2 301 to 450 mm: four sash locks complete with safety chain.
.3 451 to 1000 mm: piano hinge and minimum two sash locks.
.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

2.4 TURNING VANES

.1 Factory or shop fabricated to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Flexible Connections:

.1 Install in following locations:
- .1 Inlets and outlets to supply air units and fans.
- .2 Inlets and outlets of exhaust and return air fans.
- .3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:
- .1 Ducting on sides of flexible connection to be in alignment.
- .2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Locations:
- .1 Fire and smoke dampers.
- .2 Control dampers.
- .3 Devices requiring maintenance.
- .4 Required by code.
- .5 Reheat coils.
- .6 Elsewhere as indicated.

.3 Instrument Test Ports:

.1 General:
- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations:
- .1 For traverse readings:
  - .1 Ducted inlets to roof and wall exhausters.
  - .2 Inlets and outlets of other fan systems.
  - .3 Main and sub-main ducts.
  - .4 And as indicated.
- .2 For temperature readings:
  - .1 At outside air intakes.
  - .2 At inlet and outlet of coils.
  - .3 Downstream of junctions of two converging air streams of different temperatures.
  - .4 And as indicated.

.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Heat exchangers shall be compatible with chlorinated swimming pool water.

.2 Provide one spare set of gaskets for each heat exchanger.

.3 Delivery lead time not to exceed 8 weeks.

1.2 REFERENCES

.1 CSA International

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.

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

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

.5 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for heat exchangers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect heat exchangers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 WATER TO GLYCOL HEAT EXCHANGERS (HX-1A & HX-1B)

.1 Design

.1 To reduce installation and maintenance cost, units should be designed as single pass units unless thermal and hydraulic conditions require multi-pass arrangement.

.2 For single pass units all connections should be located on the fixed head, frame plate, allowing the movable head, pressure plate, to slide back and plates added, removed, or replaced from the plate pack without disturbing the connections or associated piping.

.3 The design should allow for the removal of interior plates without the removal of the plates.

.4 The unit shall be provided with an aluminum or stainless steel OSHA splash shield.

.5 The unit shall be designed, hydro-tested, and U-1 stamped in accordance with ASME Section VIII Division 1.

.2 Frame

.1 The frame plate and pressure plate should be carbon steel SA 516 grade 70.

.2 The frame and pressure plate shall be of sufficient thickness to meet the ASME design pressure. Stiffeners or support brackets are not allowed.

.3 Carbon steel frame components shall be painted with gray epoxy paint.

.4 Units with 3-inch or greater connections shall be unlined or alloy lined studded ports to mate with raised face or flat faced ANSI flanges. Rubber liners are not allowed.

.5 Units with 2 or 2 1/2-inch connections shall have carbon steel female tapped NPT or male NPT connections if an alloy material is required.

.6 Units with 1-inch ports shall have carbon steel or 316 stainless steel female tapped NPT or alloy material male NPT connections.

.7 Units with connections greater than 50mm (2-inch) require that the thermal plates be supported by the carry bar, top bar. The guide bar, bottom bar, shall only help properly align the plates.

.8 The pressure plate shall be supported by a roller assembly from the carry bar for units with 65mm (2 1⁄2-inch) or greater port sizes.

.9 The carry and guide bar plate contact surfaces shall be corrosion resistant.

.10 The design for units with 2-inch connections or smaller allow the plates be supported by the guide bar, bottom bar, and the carry bar, top bar, shall help properly align the plates. Carry and guide bars are to be steel with a zinc chromate coating.

.3 Tightening Bolts

.1 Tightening bolts shall be zinc plated carbon steel SA193 B7.

.2 The tightening bolt assemblies shall include captive working nuts at the pressure plate, rear head, such that the unit can be opened and closed with one wrench from the front of the unit.

.4 Plates

.1 Plates shall be pressed in a one step stamping process.

.2 Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate and carry bar and guide bar. Welded on hanging brackets or stiffeners are not acceptable.

.3 The plate pack shall use a positive plate to plate alignment system to ensure proper plate to gasket seals throughout the plate pack. The positive alignment system shall either be a gasket lug which fits within a plate recess on the proceeding plate (tongue in groove) to align successive plates or an extended rolled edge hanger which nests successive plates through direct contact around the entire plate hanger. Plate designs, which only offer alignment through contact with the carry and guide bar, are unacceptable.

.4 Plates shall be permanently marked to indicate plate material and thickness.

.5 Gaskets

.1 All gaskets except the gasket on the first plate shall be identical.

.2 The gaskets shall be a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination.

.3 Gasket attachment methods, which break during gasket removal or plate maintenance thus destroying the gasket, are not allowed.

.4 Care should be taken in the selection of gasket materials to insure compatibility with the fluids and operating temperatures.

.6 Selection, Certification and Testing

.1 The manufacturer shall provide written guarantee to the accuracy of the heat exchanger thermal design.

.2 The manufacturer shall be certified with the Air-Conditioning and Refrigeration Institute's Liquid to Liquid Heat Exchanger Certification program ARI Standard 400 for the Model being supplied.

.3 Should the Heat Exchanger not perform to the specified conditions as defined in the ARI Standard 400, the manufacturer is responsible to replace or repair the exchanger to achieve the stated performance.

.4 If the manufacturer is not certified with the Air-Conditioning and Refrigeration Institute's Liquid to Liquid Heat Exchanger certification program ARI Standard 400, a witnessed factory performance test must be completed per the testing specification of ARI 400.

.7 Acceptable Product: "Bell and Gossett" model GPX or approved equivalent in accordance with B7.

.8 Heat Exchanger Schedule:

TAG: HX-1AB		
	COLD SIDE	**HOT SIDE**
FLUID CIRCULATED	50% PG	Boiler Water
TOTAL FLUID ENTERING	13.34 L/s (211.5 gpm)	8.20 L/s (192.9 gpm)
PRESSURE DROP	28.3 kPa (4.1 PSI)	22.1 kPa (3.2 PSI)
TEMPERATURE IN	37.8°C (100 °F)	71.1°C (160 °F)
TEMPERATURE OUT	60.0 °C (140 °F)	48.9°C (120.0°F)

HEAT EXCHANGED LMTD	1113 kW (3,800,000 BTUH) 20.0	
CONSTRUCTION: DESIGN PRESSURE TEST PRESSURE DESIGN TEMPERATURE PLATE MATERIAL NO. OF PLATES PLATE THICKNESS (mm) GASKET MATERIAL:	 1034 kPa (150 PSI) 1344 kPa (195 PSI) 140 °C (284°F) 304 Stainless Steel 75 0.4 Nitrile HT	
CONNECTIONS: in out	 100mm (4" 150#) 100mm (4" 150#)	 100mm (4" 150#) 100mm (4" 150#)
WEIGHT:	495 kg (1089 lbs) empty 539 kg (1187 lbs) flooded	
CODE REQUIREMENTS:	ASME Sect VII Div. 1 w/ stamp	
NOTES:	Heat exchangers shall be designed to accommodate pressure difference between hot and cold sides.	

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for heat exchanger installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.

.3 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

.4 Plate exchangers: install in accordance with manufacturer's recommendations.

3.3 APPURTENANCES

.1 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

3.4 FIELD QUALITY CONTROL

.1 Site Tests and Inspections:

.1 Perform tests as directed by Contract Administrator to ensure heat exchangers are functional.

.2 Obtain reports within 3 days of review and submit immediately to Contract Administrator.

.2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

.3 Manufacturer's Field Services:

.1 Submit 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 Ensure manufacturer's representative is present before and during testing.

3.5 SYSTEM START-UP

.1 General: perform start-up operations in accordance with Section 01 91 13 - 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.

.7 General: perform performance verification in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.

.8 Timing: only after TAB of hydronic systems have been successfully completed.

.9 Primary side:

.1 Measure flow rate, pressure drop, and water temperature at heater inlet and outlet.

.2 Control valve: verify proper operation without binding, slack in components. Measure if control is three-port type, pressure drop across inlet to common, bypass to common, inlet to bypass.

.3 Secondary side:

.1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.

.2 Verify installation and operation of air elimination devices.

.4 Calculate heat transfer from primary and secondary sides.

.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 Section 01 91 13 - General Commissioning (Cx) Requirements.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.7 DEMONSTRATION

.1 Training: provide training in accordance with Section 01 79 00 – Demonstration and Training.

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Supply, delivery, receiving, installation, and commissioning of the air handling units specified herein.

.2 Expedited delivery required. **Delivery lead time shall not exceed 12 weeks**.

1.2 REFERENCES

.1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

.1 ANSI/ARI 430-99(R2002), Central-Station Air-Handling Units.

.2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-2007, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-11-07, Environmental Standard for Paints.

.5 Master Painters Institute (MPI)

.1 MPI-INT 5.3-2007, Galvanized Metal.

.6 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)

.1 SCAQMD Rule 1113-04, Architectural Coatings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation, filters, adhesives, and paints, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following: fan, motor drive, voltage, total and sensible cooling, filters, mixing box, dampers, coil; include performance data.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

.2 Provide five spare sets of filters.

.3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

Part 2 Products

2.1 AIR HANDLING UNITS (AHU-1 & AHU-2)

.1 Unit Construction:

.1 Unit casing shall be of minimum 18 gauge (1.3mm) satin coat galvanized sheet metal.

.2 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.

.3 The entire airstream shall be provided with a 22 gauge (.85mm) solid galvanized metal liner over insulated areas. Provide metal liner on underside of unit.

.4 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and access plenums. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.5 Units shall be provided hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units.

.6 All units shall be internally insulated with 2"(51mm) thick 3 lb./cu.ft. (48 kg./cu.m.) density insulation.

.7 3 lb./cu.ft. (48 kg/cu.m.) insulation is secured with steel angles. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

.8 Cooling coil drain pans for future coil shall be fabricated of stainless steel and are an integral part of the floor paneling, a minimum of 2" (51mm) deep, with welded corners. Drain pans shall extend a minimum of 6" (152mm) downstream of coil face and be provided with a 1 ½" (38mm) S.S. M.P.T. drain connection. Drain pans must have a fast pan and be sloped and pitched such that there is no standing water. Intermediate fast pans shall be provided between cooling coils where required for effective moisture removal.

.9 The floor is to act as drain pan (Wash down interior) complete with 2” (51mm) upturn standing seams around perimeter (or 2” (51mm) perimeter collar continuously welded to the unit base) and welded corners to ensure the floor is watertight. Alternately screwing down, tack welding and caulking of this collar is not acceptable. Provide 1 ½” (38mm) drain connections for complete drainability of the base pan.

.10 Service corridor (integral) shall be insulated with 2"(51mm) thick nominal 3 lb./cu. ft.(48 kg/cu. m) density acoustic insulation. Corridor shall also be fully lined with 22 gauge (0.85mm) solid liner. Floor to be 14 ga. (2.0mm) galvanized floor with rust resistant non-skid coating.

.11 Provide pipe chase with upstanding floor breaks and covers to be located under each coil location, including future coil locations, along with an electrical chase under the electrical control cabinet located in the service corridor.

.12 Access door(s) to service corridor shall be complete with zinc plated piano hinges and brass pins in welded steel frames. Access doors from service corridor to internal unit components shall be as specified elsewhere.

.13 Service corridor to be provided with marine lights with Lexan globes wired in EMT to a switch with pilot light. Corridor shall also be provided with a 1.5 kW electric baseboard heater and integral thermostat and duplex service receptacle.

.14 Lights, heater and service receptacle shall be powered via transformer from the single main feed power supply. Main unit disconnect and convenience circuit disconnect by Division 26.

.15 For swimming pool applications the following specialized construction and features for air handling units shall be provided:

- Inlet and relief with openings on opposite sides of unit.
- 100mm (4") Drain pan in mixing section.
- Motors to be TEFC Super-E with 1.15 service factor.
- Blower and motor drive belts shall have a 1.5 service factor.
- Solid liner throughout unit interior.
- Two part epoxy coat interior and exterior including blowers and damper blades.
- Heresite coat coils in units with fluid heating and/or cooling.
- Coat fan shafts with chlorine resistant coating.
- Gasket and/or caulk seal all opening between control panel and the air stream.

.16 In air-to-air heat reclaim units, the exhaust section drain pans shall be an integral part of the floor paneling, a minimum of 2" (51 mm) deep, with welded corners. Drain pans shall extend over the full exhaust fan plenum and be connected with a 1 ½"(38 mm) M.P.T. drain connection.

.17 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1"(25mm) galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼"(6mm) below the floor panel; drain trap(s) connections for field supply and installation of drain traps.

.18 Outdoor pre-heat coil shall include outside air shut-off and secondary pre-heat coil bypass dampers. The bypass dampers shall be opened when mechanical cooling or economizer function is enabled.

.2 Fans:

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.2 Single low pressure forward curved fans shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame.

.3 Fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.

.4 Provide full section return air fan(s) as scheduled. The use of power exhaust propeller or centrifugal fan arrangements will not be considered.

.5 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.

.6 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" (25mm) static deflection designed to achieve high isolation efficiency. Use of separate bumper or snubber is not acceptable. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

.7 Provide single extended grease line from far side to access side bearing.

.8 Fan motors shall be TEFC (totally enclosed fan cooled) Super E high efficiency type.

.3 Coils:

.1 Coils shall be 5/8" O.D. constructed of copper tube, aluminum fin, and copper headers with schedule 40 steel pipe connectors.

.2 Fins constructed of aluminum or copper shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.

.3 Headers shall be outside the air-handling unit for maximum serviceability except for blow through applications where headers are internal. The non-headered end of the coil shall be fully concealed. Provide auxiliary drain pan complete with ½" (13mm) MPT drain connection at headered end of cooling coils.

.4 All water coils shall be equipped with a capped vent tapping at the top of the return header or connection, and a capped drain tapping at the bottom of the supply header or connection.

.5 Water and glycol coils shall be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.

.6 5/8” O.D. tube diameter water coils shall be ARI Certified.

.7 Provide Heresite P-413C, a pure phenolic with plasticizers thermosetting resinous coating to protect the coils against exposure to corrosive atmospheres. The process shall be accomplished by a multiple coat application of degreasing and etching, dipping and baking (four times), resulting in complete coating coverage of the fins, tubes, headers and casing. Salt spray tested to ASTMB-117 standards.

.4 Filters:

.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.

.2 The filter modules shall be designed to slide out of the unit. Side removal 2" (50mm) filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.

.3 2"(50mm) Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Permanent re-usable metal enclosing frame. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

.4 Filter media shall meet UL Class 2 standards.

.5 Dampers:

.1 Damper frames shall be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13mm) aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.

.2 Blades shall be 18 gauge (1.3mm) galvanized metal with two breaks on each edge and three breaks on centerline for rigidity. The pivot rod shall "nest" in the centerline break. Damper edges shall interlock. Maximum length of damper between supports shall be 48”(1219 mm). Damper linkage brackets shall be constructed of galvanized metal.

.3 Mixing dampers shall be standard construction and include blade ends sealed with an adhesive backed foamed polyurethane gasketting. Outdoor air dampers shall be insulated and include an all-weather PVC seal fastened with a positive lock grip and pliable overlap edge on entering air side of interlocking edges. Dampers are interlocked from the center. Exhaust, inlet and pre-heat bypass dampers shall be extruded aluminum, low leak, thermally broken, insulated blade Tamco Series 9000.

.4 Mixing dampers shall be parallel blade type.

.5 Two position inlet dampers shall be parallel blade type.

.6 Motorized relief dampers shall be parallel blade type.

.7 Damper actuators by Section 23 09 33.

.6 Factory Supplied Controls/Wiring

.1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.

.2 Automatic controls shall be housed in a control panel mounted in the service corridor, which will meet that standard of the specific installation.

.3 Provide a discharge air low limit equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure, this device will shut down the fan and close the outdoor air damper. Provide freeze stat alarm contact for remote alarming via BMS.

.4 Start/Stop contact for supply and return blower to be wired to a terminal strip located in the service corridor.

.7 AHU vendor shall provide on-site support to the BMS Subcontractor during commissioning of the control system.

.8 Air handling unit schedule:

AIR HANDLING UNIT SCHEDULE		
TAG		AHU-1 & 2
SERVICE		Public Swimming Pool
MANUFACTURER		Engineered Air
MODEL		LM18/C/O
SUPPLY	CFM:	16,000
	ESP (“WC):	1.5
	MOTOR (HP):	20
	BLOWER:	27/27
RETURN	CFM:	16,000
	ESP (“WC):	1.0
	MOTOR (HP):	15
	BLOWER:	27/27
PRE-HEAT	EAT / LAT (°F):	-30 / 68.3
	EWT /LWT (°F):	140 / 103 (50% P.G.)
	TOTAL (MBH):	700 (6,600 CFM)
HEATING	EAT / LAT (°F):	68 / 105
	EWT /LWT (°F):	140 / 104 (50% P.G)
	TOTAL (MBH):	646 (16,000 CFM)
UNIT DIMENSIONS (WxLxH):		4496 mm x 7137 mm x 2591 mm
Unit Weight:		5,000kg (11,000 lb)
REMARKS:		Refer to mechanical drawings for orientation, orientation of each unit differs. Provide cooling coil cavity w/ drain pan for future coil.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Provide appropriate protection apparatus.

.2 Install units in accordance with manufacturer's instructions and as indicated.

.3 Ensure adequate clearance for servicing and maintenance.

3.3 FANS

.1 Install fan sheaves required for final air balance.

.2 Install flexible connections at fan inlet and fan outlets.

.3 Install vibration isolators.

END OF SECTION