GREENING NORTHERN HOUSING

Pond Inlet, Nunavut

PROJECT MANUAL – VOL. 2

Divisions 20-33

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Parks Canada Parcs Canada

kobayashi+zedda

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 All referenced standards shall be to the most recent edition.

.3 National Fire Prevention Association (NFPA)

.1 NFPA 10, Standard for Portable Fire Extinguishers.

.4 National Research Council Canada (NRCC)

.1 National building Code of Canada (NBCC).

1.3 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 all products and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

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 all equipment in this section for incorporation into manual.

.1 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.

.2 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.3 Additional data:

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

1.5 SCOPE OF WORK

.1 The contractor shall allow for the following items:

.1 Fire Extinguishers

1.6 MATERIALS

.1 Standard of Acceptance means that item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

.2 Equipment and material shall be installed and tested in accordance with the detailed recommendations of the manufacturer. Where there is a discrepancy between the drawings and/or the specifications and the manufacturer's written installation instructions, the most stringent shall be followed.

.3 All materials shall be CSA certified.

1.7 INTENT

.1 Work shall be in accordance with the specifications and their complete with all necessary components, including those not normally shown or called for, and ready for operation before acceptance.

1.8 RESPONSIBILITY

.1 Promptly advise the Owner of any specified equipment and/or material which appears inadequate or unsuitable; in violation of laws, ordinances, rules, or regulation of authorities having jurisdiction; of any necessary items of work omitted from the Contract Documents; or of any discrepancies in the Specification.

.2 During freezing weather, protect all materials in such a manner that no harm can be done to installations already in place. Schedule work as required.

1.9 SCHEDULING

.1 Coordinate with Division 1 Construction Schedule.

.2 Incorporate into the Construction Schedule, a complete and realistic schedule, intergrated with and recognizing the reliance on, other trades. Take into account lead times for delivery, review, installation, and start-up.

.3 Add project specific schedule requirement such as after hours work

1.10 EQUIPMENT INSTALLATION

.1 Provide means of access for servicing, disassembly, and removal of equipment, valves and components.

.2 Pipe system drains to floor drains.

.3 Line up equipment, piping and similar items parallel to or perpendicular to building walls.

.4 Flexible couplings: Install to provide for differential movement during seismic events between attachment points in accordance with NFPA 13. Provide additional supports as required.

Part 2 Products - Not Used

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 equipment installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 00 - Interior Painting.

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

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

3.3 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 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.2 The General Conditions, Supplements, Amendments and Mechanical General Requirement shall govern the plumbing sections. This section covers items common to Div. 22.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 National Research Council Canada (NRCC)

.1 National Building Code of Canada (NBCC).

.2 National Plumbing Code of Canada (NPCC).

1.3 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 materialk specified in Div 22 and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 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.

.3 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.

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 all plumbing materials and equipment for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

.2 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.

.3 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.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after start-up 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.

.5 Approvals:

.1 Submit 3 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative .

.6 Additional data:

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

.7 Site records:

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

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

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-built drawings:

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

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

.3 Submit to Departmental Representative for approval and make corrections as directed.

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

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

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

1.5 OCCUPANCY DOCUMENTATION

.1 The contractor shall submit the following documentation to the Departmental Representative a minimum of 5 working days prior to the project occupancy site walk-through or occupancy date, whichever is scheduled first. The dates will be established by the project architect, project manager or Certified Professional. It is the contractor's responsibility to provide all documentation to the Departmental Representative in a timely manner. If all documentation is not received, the Departmental Representative may not be able to issue their associated Letter of Design Assurance in support of the building occupancy application and any associated consequences shall become the responsibility of the contractor.

.2 Anchorage and Seismic restraint systems Letter of Design Assurance and Assurance of Professional Design and Commitment for Field Review sent to Authority Having Jurisdiction and copied toDepartmental Representative. Provide restraint shop drawings for major equipment.

.3 Letter confirming that all penetrations of rated assemblies have been firestopped in conformances with CAN-S115.

.4 Copies of Pressure test reports for all piping systems on the installers letterhead.

.5 Flushing, Disinfection and Chlorination certificates for potable water systems.

.6 Plumbing Inspectors final certificate.

.7 Gas Inspectors Final Certificate.

.8 Maintenance Manuals for Plumbing Systems.

1.6 ANCHORAGE, SUPPORT AND SEISMIC RESTRAINT

.1 Refer to Section 23 05 48.

.2 The Contractor shall retain an engineer registered in the Northwest Territories & Nunavut to determine the anchorage and seismic restraint requirements for this project and become the Engineer of Record for this discipline. Verification and certification to the satisfaction of the Authorities Having Jurisdiction will be required prior to Substantial Completion. Engineer shall submit a letter of assurance to the authority having jurisdiction for this work.

.3 Scope to include anchorage, support, bracing and restraint of all equipment installed under this division.

1.7 RESPONSIBILITY

.1 Promptly advise the Departmental Representative of any specified equipment and/or material which appears inadequate or unsuitable; in violation of laws, ordinances, rules, or regulation of authorities having jurisdiction; of any necessary items of work omitted from the Contract Documents; or of any discrepancies in the Specification.

.2 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra costs to the Owner without the Owner's written approval.

.3 Ensure that equipment does not transmit noise and/or vibration to other parts of the building as a result of poor installation practice.

.4 Pay for permits required by the Authority Having Jurisdiction. Arrange for applicable inspections.

.5 Prior to tendering, a site visit or equivalent is recommended for the familiarization with local and existing conditions on which the work is dependent. No additional charges will be considered for items which are not concealed.

.6 Work carried out in the existing building shall be conducted to minimize disruption to occupants.

1.8 WORKMANSHIP

.1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by Departmental Representative and the Trade. Work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish, and appearance shall be repaired at the Contractor’s expense.

.2 Employ only tradesmen holding valid Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

1.9 DRAWINGS AND SPECIFICATIONS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Do not scale the drawings.

.2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.

.3 Take field measurements where equipment and material dimensions are dependent upon building dimensions.

.4 The drawings and specifications are complimentary to each other, and what is called for in one shall be binding as if called for in both.

.5 Should any discrepancy between the drawings and specifications be present, it is the responsibility of the contractor to notify the Engineer prior to the closing of the tender. If not done, it will be assumed that the contractor has allowed for the most expensive option.

1.10 EQUIPMENT INSTALLATION

.1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.

.2 Provide means of access for servicing, disassembly, and removal of equipment and components including permanently lubricated bearings.

.3 Pipe equipment drains to floor drains.

.4 Line up equipment, rectangular cleanouts and similar items parallel to or perpendicular to building walls.

.5 Flexible couplings: Install to provide for differential movement during seismic events between attachment points.

.6 Expansion joints: Install on any straight run of pipe longer than 100 feet (30m) and where necessary to prevent unacceptable loading on pipes and fittings.

1.11 PROTECTION OF OPENINGS

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

1.12 ELECTRICAL

.1 Electrical work is to conform to Division 26 specifications. The following electrical work is included in Division 25.

.1 All conduit, wiring, and connections 50V and under relating to mechanical systems including installation of transformers. Refer to Division 26 for further clarification.

1.13 TESTS

.1 Give 72 hours notice of date for tests, during regular working hours.

.2 Insulate or conceal work only after testing and approval by Departmental Representative

.3 Conduct tests in presence of Departmental Representative where requested.

.4 Bear costs, including cost of heating, for all testing under this division and Division 26, retesting, and making good.

.5 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.14 PAINTING

.1 Apply at least one coat of corrosion resistant primer paint and two coats or corrosion resistant paint to ferrous supports and site fabricated work.

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

.3 Restore to new condition finishes which have been damaged too extensively to be merely primed and touched up.

1.15 DISSIMILAR METALS

.1 To be compatible with and to suit pressure rating of piping system.

.2 Where pipes of dissimilar metals are joined in all open, non-treated fluid systems, provide dielectric unions and system grounding to the requirements of Div. 26. Dielectric unions to be rated to 80C and tested to 1.5 times the sytem working pressure.

1.16 EQUIPMENT SUPPORTS

.1 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of Seismic Engineer.

.2 Mount base mounted equipment on housekeeping pads provided by General Contractor where indicated on the drawings.

Part 2 Products

2.1 ACCESS DOORS

.1 Provide for all concealed equipment, tanks or valves requiring access for servicing or repair.

.2 Design;

.1 Construct and install to the requirement of Div 01.

.2 Drywall construction; Min. 16ga thick for 400x400mm and smaller, 14ga thick for 450x450mm and larger, bonerdized steel face with exposed flange,

.3 For water resistant finished wall, tile or ceramic or wet wall construction; 14ga thick stainless
steel flush with wall or ceiling with concealed hinge and water tight opening.

.3 Minimum Requirements; Concealed hinges, adjustable anchoring straps or lugs to suite construction.

.4 Size:

.1 200x 200mm for cleanout or valve access.

.2 300 x 300mm for hand accesss.

.3 600 x 600mm for entry access.

.4 Larger as required to suit equipment

.5 Lockable when installed in public areas, screwdriver cam lock in service areas.

.6 Access panels in fire separations shall have compatible ULC rating and listing. Doors shall be insulated and spring return hinges.

2.2 FIRESTOPPING

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

.2 Firestopping to be completed in accordance with Division 7 and the reference standards with listed intumescent sealant to manufacturer's and cUL listings for rated assembly penetration. Provide manufacturer's cUL shop drawing details for every different rated assembly penetration. Jobsite conditions of each through penetration firestop system must meet ALL details of the cUL-Classified System selected. If jobsite conditions do not match any cUL-classified systems, contact manufacturer for alternative systems. Coordinate work with other trades to assure that penetration opening sizes are appropriate for penetrant locations.

.3 All piping penetrations through 45 minute rated assemblies to be cold smoke sealed/fire sealed with listed intumescent sealant or approved cold smoke sealed at fire penetrations to sealant cUL listing.

.4 Contractor to submit shop drawings from the fire stop manufacturer with each approved fire stop solution and the installation requirements clearly indicated.

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 installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23 - Interior Painting.

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

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

3.3 DEMONSTRATION

.1 Departmental Representative 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 Water and Sanitary holding tank fill and suction system inclusive of alarms and controls.

.2 Domestic water system including heating system

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

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

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

.6 Departmental Representative may record these demonstrations on video tape for future reference.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

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 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 ASTM International (ASTM)

.1 ASTM A126-04 (2019), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62-15, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 American Water Works Association (AWWA)

.1 ANSI/AWWA C700-20, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.

.2 ANSI/AWWA C701-19, Standard for Cold Water Meters-Turbine Type for Customer Service.

.3 ANSI/AWWA C702-19, Standard for Cold Water Meters-Compound Type.

.4 CSA Group (CSA)

.1 CSA-B64 Series-2011(R2016), Backflow Preventers and Vacuum Breakers.

.2 CSA B79-R2018, Commercial and Residential Drains and Cleanouts.

.5 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada 2015 (NPC).

.6 Plumbing and Drainage Institute (PDI)

.1 PDI-WH201-R2017, Water Hammer Arresters Standard.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings:

.1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with contractor's representative in accordance with Section 01 31 19 - Project Meetings to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building construction subtrades.

.4 Review manufacturer's written installation instructions and warranty requirements.

1.4 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 plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings to indicate number of anchors, dimensions, finishes and accessories for all materials .

.4 Instructions: submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.6 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 plumbing materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 FLOOR DRAINS

.1 Floor Drains and Trench Drains: to CSA B79.

.2 Type 1: general duty ; cast iron body as indicated, adjustable head, sediment basket nickel bronze strainer, integral seepage pan, and clamping collar.

.1 Standard of Acceptance: Watts FD-200-A for concrete, Watts FD-380 for wood, Zurn, Mifab

2.2 CLEANOUTS

.1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access Covers:

.1 Wall Access: face or wall type, round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor Access: cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

2.3 WATER HAMMER ARRESTORS

.1 Copper construction, bellows type: to PDI-WH201.

.1 Standard of Acceptance: Watts HY-725,Zurn, Oatey

.2 Bronze construction, permanently sealed air chamber, listed for hot water use to 140F: to NSF-372, PDI-WH201

.1 Standard of Acceptance: Watts LF15, Zurn, Oatey

2.4 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.5 TRAP GUARDS

.1 Material: Smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom

.2 Operation: Allows wastewater to open and adequately discharge floor drain through its interior and closes and returns to original molded shape after wastewater discharge is complete

.3 Compliance: NSK/ANSI 14, CSA B79

2.6 STRAINERS

.1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS 2 and under, bronze body, screwed ends, with brass cap.

.3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.7 VENT STACK JACK FLASHING

.1 Aluminium construction, factory fabricated and insulated, deck flange and cap. Minimum 450mm high.

2.8 HEAT TRACED ARCTIC VENTS

.1 General: packaged heat traced and insulated plumbing vent.

.2 Approvals: cCSAus

.3 Plumbing:

.1 75mm slip fit coupling

.2 75mm ID freeze protected LEXAN enclosure

.3 125mm insulated outside diameter

.4 Electrical:

.1 Enclosure: 3R for outdoor use

.2 Power: 120V, 75W

.3 Self regulating conductive polymer heat cable

.4 Themo plastic elastomer jacket

.5 2m lead with 27mA GFC interrupter plug in device

.5 Control:

.1 On/off thermostatic

.2 One thermostat for each drainage vent

2.9 WASHER BOX

.1 Flush with wall, with RH or LH outlet as required, with lever operated ball valves 19mm, hose end outlets, with water hammer arrestors, and 12.7 mm H & CW connection. Provide accessible service stops, on water lines and 50 mm 'p' Trap on drain.

.2 Acceptable Material: PPP, Oatey, Eastman.

2.10 DRAIN WATER HEAT RECOVERY UNIT

.1 Construction: Copper heat exchanger core in plastic housing. All materials and equpment to be tested to the requirements of NPCC and ASTM.

.2 Size: 50mm drain connection, 1200mm long.

.3 Orientation: Unit shall be tested and configured for nonmial horizontal installation with heat exchanger surfance on bottom of the internal core. Install at 5deg as directed by manufacturer.

.4 Unit shall be tested and rated for continous operation at 60C and rated for an 24% heat recovery based on 75% system efficiency and 15C cold water temperature

.5 Acceptable Material: Ecodrain B1000, PowerDrain, Thermodrain

2.11 EXPANSION AND PRESSURE TANKS

.1 Expansion Tanks:

.1 General: cylindrical steel pressurized diaphragm type expansion tank, red oxide primer finish, stainless steel system connector, shrader valve with EPDM seat, polypropylene anti legionella liner.

.2 Diaphragm: sealed butyl suitable for potable water, NSF/ANSI 61

.3 Working Pressure: 860 kPa.

.4 Air Precharge: 380 kPa

.5 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

.6 Schedule:

.1 Domestic Expansion Tanks
.1 Volume: 14L
.2 Min Acceptance Volume: 6.8L
.3 Dimensions: 280 Dia x 380mm H

.2 Pressure Tanks:
.1 General: cylindrical steel pressurized diaphragm type potable water pressure tank
.2 Diaphragm: sealed butyl suitable for potable water
.3 Working Pressure: 1035 kPa
.4 Air Precharge: 276 kPa
.5 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
.6 Schedule:
.1 Pressure Tank
.1 Volume: 167L Total, 128 L Acceptance
.2 Dimensions: 650mm Dia x 915mm H

2.12 TANKS

.1 Potable Water Storage Tanks;
.1 General: heavy duty, free standing, above ground low profile tank with specified connections
.2 Complete tank assembly to be rated for seismic installations. Provide written verification of compliance. See Section 23 05 48.
.3 Tank Design
.1 Single wall vessel
.2 Horizontal, low profile configuration
.3 The tank size, fittings and accessories shall be as shown on the drawings and specified
.4 One piece seamless polyethylene construction with UV inhibitors
.5 FDA approved for potable water use
.6 Tank shall be manufactured with structural ribs which are fabricated as in integral part of the tank design
.7 Tank shall be vented to atmospheric pressure
.8 Tank shall be capable of handling liquids with specific gravity up to 1.1
.9 Tank shall be compatible with liquids identified in the manufacturer's standard limited warranty
.4 Accessories:
.1 Piping and Fittings: Tanks shall be equipped with bulkhead fittings for field installation of piping

.2 Manway Openings: The standard manway shall be threaded type, 15” and vented with cover.

.3 Drop Tubes:

.1 Inlet of fill drop tubes to allow low level discharge of inlet or fill water.

.2 Pipe type to match connecting pipe

.3 Terminate at 50mm (2”) above tank invert with diffuser or T-fitting

.5 Tank Capacity, Dimensions & Type:

.1 TK-1.1: 635 Imp gallons, 91” width x 80” length x x25” height, DW storage

.6 Tank Connections

.1 Fill: 50mm top, c/w with fill connection to suit municipality requirements.

.2 Overflow Vent: side

.3 Level control: 100mm (4”)

.2 Sanitary Tanks;

.1 General: custom FRP construction, heavy duty, free standing, above ground low profile tank with specified connections

.2 Complete tank assembly to be rated for seismic installations. Provide written verification of compliance. See Section 23 05 48.

.3 Tank Design

.1 Constructed and Certified to CSA-B66.

.2 Single wall vessel

.3 Horizontal, low profile configuration

.4 The tank size, fittings and accessories shall be as shown on the drawings and specified

.5 Custom FRP construction

.6 FDA approved for potable water use

.7 Tank shall be manufactured with structural ribs which are fabricated as in integral part of the tank design

.8 Tank shall be vented to atmospheric pressure

.9 Tank shall be capable of handling liquids with specific gravity up to 1.1

.10 Tank shall be compatible with liquids identified in the manufacturer's standard limited warranty

.4 Accessories:

.1 Piping and Fittings: Tanks shall be equipped with bulkhead fittings for field installation of piping

.2 Manway Openings: The standard manway shall be threaded type, 15” and vented with cover. Coordinate location of manway opening with access door above.

.3 Drop Tubes:

.1 Inlet of fill drop tubes to allow low level discharge of inlet or fill water.

.2 Pipe type to match connecting pipe

.3 Terminate at 50mm (2") above tank invert with diffuser or T-fitting

.5 Tank Capacity, Dimensions & Type:

.1 TK-1.2: 5675L, 2390 (94) width x 3860 (152) length x 785 (31") height, Sanitary Holding Tank

.6 Tank Connections

.1 Suction: 100mm(4") top c/w connection to suit municipality requirements.

.2 Sanitary: 100mm (4") top

.3 Vent: 100mm (4")top

.4 Level Control: 100mm (4")

2.13 CONDENSATE PUMP

.1 Low profile pump system for automatic collection and removal of condensate.

.2 Pump construction to meet requirements of UL2043 and labelled for "Plenum Applications

.3 Vertical centrifugal pump, 24W motor, thermally protected fan cooled motor, 120V/1ph

.4 1.1L tank capacity

.5 Performance: approx. 150 LPH at 4m head

.6 Auto start/stop

.7 Built in check valve, 1-1/8" inlet, float activated high level switch

2.14 THERMOSTATIC MIXING VALVE

.1 Hot water supply thermostatic mixing valve to ASSE 1017, 1069 and 1070, lead-free brass construction, integral filters and check valves, selectable temperature between 26°C and 49°C, double throttling design .

.2 Acceptable Products: Watts LFMMV, Zurn Bradley

2.15 BALANCING VALVE

.1 Lead free brass body, drain plug, rated for domestic water use, sized as per the drawings, bi directional, setting memory, positive shutoff, NSF rated.

.2 Standard of Acceptance: Watts LFCSM-61.

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 Install in accordance with National Plumbing Code of Canada (NPC),.

.2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

.1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.4 NON-FREEZE WALL HYDRANTS

.1 Install 600 mm above finished grade and as indicated.

3.5 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures where indicated.

3.6 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Departmental Representative.

.3 Install soft copper tubing to floor drain.

3.7 STRAINERS

.1 Install with sufficient room to remove basket for maintenance.

3.8 TRAP GUARDS

.1 Provide for all floor drains where mechanical trap primers not supplied.

.2 Provide for all Electrical Room floor drains and floor drains where traps are not located in the crawlspace.

3.9 HEAT TRACED ARCTIC VENTS

.1 Provide for all drainage vents except where indicated on the drawings.

.2 Connect to a dedicated 120V circuit (s) for up to 6 arctic vents per vent. Coordinate requirement with Electrical contractor and include for all costs to provide the dedicated circuit (s). Claims for additional costs for power distribution will not be acceptable after the tender close.

3.10 DRAIN WATER HEAT RECOVERY UNIT

.1 Install unit as per manufacturers written instructions.

.2 Locate equipment in accessible location as indicated. Ensure maintenance access is provided around unit for cleaning and removal.

.3 Install unit sloped to ensure positive drainage.

.4 Connect domestic water as directed complete with isolation valve at each connection.

3.11 CONDENSATE PUMP

.1 Provide for condensate drainage where drainage by gravity is not available and on;

.1 ERU Core Drains

.2 Start-up pump by testing drainage lift, and discharge in accordance with manufacturers literuature.

3.12 THERMOSTATIC MIXING VALVES

.1 Install as per manufacturers instruction.

.2 Adjust discharge temperature 32°C and provide start up reports in O&Ms

3.13 START-UP

.1 Timing: start-up only after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

3.14 TESTING AND ADJUSTING

.1 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by authority having jurisdiction.

.2 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.3 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.4 Floor drains:

.1 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, removability of strainer.

.5 Clean out baskets.

.5 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O&M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.6 Access doors:

.1 Verify size and location relative to items to be accessed.

.7 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.8 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.9 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.10 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

.11 Water meters:

.1 Verify location and accessibility.

.2 Test metre reading accuracy.

3.15 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

3.16 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.2 Section Includes:

.1 Materials and installation for plumbing pumps.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.1 Material Safety Data Sheets (SDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.

.3 Shop Drawings.

.1 Submit shop drawings to indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Pump performance and efficiency curves.

.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 Manufacturers' Field Reports: manufacturers' field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:

.1 Manufacturers name, type, model year, capacity and serial number.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list with names and addresses.

Part 2 Products

2.1 MATERIALS

2.2 MULTI-SPEED WET ROTOR CIRCULATOR

.1 General: Maintenance free, self-venting, system lubricated type with horizontal motor mounted directly to the pump volute, pump will not incorporate the use of couplings nor mechanical seals of any kind

.2 Volute: stainless steel of lead free bronze for open systems.

.3 Maximum pressure : 10 Bar

.4 Temperature Range.

- .1 Bronze: 2 to 66°C.
  - .1 Maximum Ambient Temperature: 40°C

.5 Impeller: composite

.6 Shaft: ceramic

.7 Rotor can and rotor cladding: high quality stainless steel

.8 Bearings: ceramic

.9 Gasket material: EPDM

.10 Motor: Integral, non-overloading, protected, multi-speeds

.11 For DHW applications: Provide internal digital timer and thermstatic controller.

.12 Approvals: cULus listed

.13 Accetpable Material: Grundfos, Taco, B&G

.14 Power: 120V/1ph/60Hz

.15 Capacity:

- .1 P-2:
  - .1 Service: Hot Water Recirculation
  - .2 Capacity: 0.03 L/s @ 0.8m
  - .3 Power: 120V/1ph/60
- .2 P-3&4:
  - .1 Service: Heating Source
  - .2 Capacity: 0.23 L/s @ 1.4m
  - .3 Power: 120V/1ph/60

2.3 DCW PRESSURE PUMP

.1 Pump:

- .1 Cast iron base and motor bracket.
- .2 Molded impeller and diffuser, stainless steel wear ring, priming screen.

.3 Mechanical shaft seal with ceramic face and stainless steel construction.

.4 Convertible, shallow well.

.2 Motor:

.1 Heavy duty, double bearing design and voltage selector switch

.2 0.6 kW, 120 V/1ph/60Hz.

.3 Approvals: CSA

.4 Control: pressure switch with adjustable on/off settings, fixed140 kPa pressure differential, prewired to motor and with pressure tapping to casing.

.5 Capacity:

.1 P-1: 76 L/min at 30m.

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 Do work in accordance with CAN/CSA-B214.

.2 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.3 Ensure pump and motor assembly do not support piping.

.4 Align vertical pit mounted pump assembly after mounting and securing cover plate.

.5 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges. Install with bearing lubrication points accessible.

3.3 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Check power supply.

.2 Check starter protective devices.

.2 Start-up, check for proper and safe operation.

.3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.

.4 Adjust flow from water-cooled bearings.

.5 Adjust impeller shaft stuffing boxes, packing glands.

3.4 START-UP

.1 General:

.1 Mechanical contractor is reposnble for the start-up and operational checks of all pumps and equipment install by this Division.

.2 Procedures:

.1 Check power supply.

.2 Check starter O/L heater sizes.

.3 Start pumps, check impeller rotation.

.4 Check for safe and proper operation.

.5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.

.6 Test operation of hands-on-auto switch.

.7 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.

.8 Run-in pumps for 12 continuous hours.

.9 Adjust alignment of piping and conduit to ensure full flexibility.

.10 Eliminate causes of cavitation, flashing, air entrainment.

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

3.5 PERFORMANCE VERIFICATION (PV) PRESSURE BOOSTER PUMPS

.1 Obtain manufacturer's approval, before performing PV, to ensure warranties remain intact.

.2 Application tolerances:

.1 Flow: +/- 10 %.

.2 Pressure: Plus 20 %, minus 5 %.

.3 PV procedures:

.1 Open pump balancing valve fully.

.2 Measure differential pressure (DP) across pump.

.3 Measure amperage and voltage and compare with manufacturer's data sheets and motor nameplate data.

.4 If suction is different size than discharge connection, add velocity head correction factor to DP.

.5 Mark this DP on manufacturer's pump curve.

.6 If flow rate is higher than specified, slow close balancing valve until specified DP is reached.

.7 Repeat measurements of amps and volts. Compare with manufacturer's data sheets.

.8 Calculate BHP and compare with nameplate data.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 American Society of Mechanical Engineers International (ASME)

- .1 ANSI/ASME B16.15-18, Cast Cooper Alloy Threaded Fittings, Classes 125 and 250.
- .2 ANSI/ASME B16.18-18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22-18, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.24-16, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
- .5 ASME B16.26-18, Cast Copper Alloy Fittings for Flared Copper Tubes.

.3 ASTM International (ASTM)

- .1 ASTM A182/A 182M-21, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
- .2 ASTM B32-2020, Standard Specification for Solder Metal.
- .3 ASTM B42-20, Seamless Copper Tube, Standard Sizes.
- .4 ASTM B88M-20, Standard Specification for Seamless Copper Water Tube (Metric).
- .5 ASTM F876-18, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- .6 ASTM F877-14, Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold Water Distribution System.

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

- .1 AWWA C904-06, Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76mm), for Water Service.

.5 CSA Group (CSA)

- .1 CSA B137.5-20, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
- .2 CSA B242-05(R2021), Groove and Shoulder Type Mechanical Pipe Couplings.

.6 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC S101-14, Fire Endurance Tests of Buildings Construction and Materials.

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

- .1 MSS-SP-67-11, Butterfly Valves.
- .2 MSS-SP-80-19, Bronze Gate, Globe, Angle and Check Valves.

.8 National Research Council (NRC)

.1 National Plumbing Code of Canada (NPC) 2015.

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 and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Place materials defined as hazardous or toxic in designated containers.

Part 2 Products

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground:

.1 Copper tube, hard drawn, type K: to ASTM B88M.

.2 PEX Piping to CSA B137.5.

.2 Civil Connections, through wall and a maximum 300mm inside building unless otherwise approved: Pipe, insulation and jackets, fittings and joints and installation to Division 31.

.3 Buried or embedded:

.1 PEX Piping to CSA B137.5.

.2 Domestic Water Tank Fill:

.1 Inside Building: Schedule 80 polyvinyl chloride (PVC) to ASTM D1785 and CSA-B137.3.

.2 Outside building and within 3m of entrance: Copper tube, hard drawn, type K: to ASTM B88M.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.

.2 Cast copper, solder type: to ANSI/ASME B16.18.

.3 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.4 NPS 1 ½ and smaller:

.1 Wrought copper to ANSI/ASME B16.22 ; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

.2 PEX fittings to CSA B137.5.

2.3 JOINTS

.1 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.2 Solder: lead-free.

.3 Teflon tape: for threaded joints.

.4 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

.5 NPS 1 ½ and smaller: PEX fittings to CSA B137.5.

2.4 VACCUM RELIEF

.1 Installed on cold water inlet of hot water tanks

.1 CSA Listed, 860kPa (125 psi) rating

.2 Acceptable products: Watts 36A, Zurn, Fabco

2.5 SWING CHECK VALVES

.1 NPS 2 and under, soldered:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

.2 Acceptable Products: Crane 37, Red & White, Toyo 326.

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

2.6 BALL VALVES

.1 NPS 2 and under, screwed:

.1 Class 150.

.2 Bronze Forged Brass body, stainless steel ball, PTFE adjustable packing, brass gland and Bunan PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.

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 in accordance with local authority having jurisdiction.

.2 Install pipe work in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.

.4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.6 Valves

.1 Isolate equipment, fixtures and branches with ball valves.

.7 PEX Piping;

.1 Assemble tubing using fittings manufactured to ASTM standards.

.2 Install in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.

.3 Do not install PEX tubing within 152 mm of appliance vents or within 305 mm of any recessed light fixtures.

.4 Do not solder within 457 mm of PEX tubing. Make sweat connections prior to making PEX connections.

.5 Do not expose PEX tubing to direct sunlight for more than 30 days.

.6 Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.

.7 Protect PEX tubing with sleeves where abrasion may occur.

.8 Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.

.9 Use tubing manufacturer-supplied bend supports where bends are less than six times the outside tubing diameter.

.10 Minimum horizontal supports are to be installed not less than 800mm centres or in accordance with local plumbing codes and the manufacturers directions.

3.3 PRESSURE TESTS

.1 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.4 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to local potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.5 PRE START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.7 START-UP

.1 Timing: start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring HWS storage tank up to design temperature slowly.

.4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

.1 Scheduling:

.1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.2 Sterilize HWS and HWC systems for Legionella control.

.3 Verify performance of temperature controls.

.4 Verify compliance with safety and health requirements.

.5 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.6 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

3.9 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 ASTM International (ASTM)

.1 ASTM D2235- 04(2016), Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D2564- 20, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.

.3 CSA Group (CSA)

.1 CAN/CSA-Series B1800- 11, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.

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

.1 Material Safety Data Sheets (SDS).

.5 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada 2015 (NPC).

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 piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Store at temperatures and conditions recommended by manufacturer.

Part 2 Products

2.1 PIPING AND FITTINGS

.1 For above ground DWV piping to:

.1 DWV ABS to CAN/CSA-B181.1-96 and CAN/CSA-B1800-02. ABS piping to be Schedule 40 and solid core construction.

.2 Uninsulated copper piping DWV is to be used for last 3m before roof vent penetration.

.2 For Sanitary Suction Piping;

.1 DWV PVC to CAN/CSA-B181.2 and CAN/CSA-B1800. PVC Suction piping to be Sch 80 and transition to steel for last 2m.

2.2 JOINTS

.1 Solvent weld for ABS: to ASTM D2235.

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 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.

.2 Install in accordance with local authority having jurisdiction and National Plumbing Code.

3.3 TESTING

.1 Pressure test all piping to requirments of reference standard.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Ensure fixtures are properly anchored, connected to system and effectively vented.

.4 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 American National Standards Institute/Canadian Standards Association (ANSI/CSA)

.1 ANSI Z21.10.3A-2019 /CSA 4.3-2019, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.

.3 CSA Group (CSA)

.1 CSA B51-19, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN/CSA-B140.0-03, Oil Burning Equipment: General Requirements.

.3 CAN/CSA-C309-2019, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

.4 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada 2015 (NPC).

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 domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section01 61 00 - Common Product Requirements.

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

Part 2 Products

2.1 OIL FIRED WATER HEATER

.1 To CAN/CSA B140.0 and CSA B140.12, with recovery rate of 477 L/h based on 5c degrees C rise and 30 kW input.

.2 Tank: 189 L, glass lined steel, 510 mm dia x 1490 mm high 50 mm CFC-free foam insulation, enamelled steel jacket. c/w 19mm water connections, block flue safety switch

.3 Oil burner: complete with one-piece combustion chamber, oil burner with flame retention head and turbo-static disc, combustion safety controls.

.4 Heater to be CSA listed and rated for combination service water and space heating.

.5 6 year warranty certificate.

.6 Acceptabel Material: John Wood JW6 F507, AO Smith. Rheem

2.2 TRIM AND INSTRUMENTATION

.1 Drain valve: NPS 1 with hose end.

.2 Drain Pan: Provide plastic drain pan under each heater with drain piped to nearest floor drain. Pan to extend past widest part of hot water heater.

.3 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.

.4 Pressure gauge: 75 mm dial type with red pointer, syphon, and shut-off cock.

.5 Thermowell filled with conductive paste for control valve temperature sensor.

.6 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.

.7 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

2.3 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation in structural steel support in accordance with Section 05 50 00 - Metal fabrications.

.2 Size anchor bolts to withstand seismic zone acceleration and velocity forces.

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 in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 Provide non combustible vented masonary base with sheet metal covering sized and installed to the installation requirements of CSA-B139.

.3 Install oil burning domestic water heaters in accordance with CAN/CSA-B139.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 CSA Group (CSA)

.1 CAN/CSA-B45 Series-02 (R2013), Plumbing Fixtures, (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9).

.2 CSA B125.3-18, Plumbing Fittings.

.3 CSA B651-18, Accessible Design for the Built Environment.

.3 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

1.3 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 washroom fixtures and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate fixtures and trim:

.1 Dimensions, construction details, roughing-in dimensions.

.2 Factory-set water consumption per flush at recommended pressure.

.3 (For water closets, urinals): minimum pressure required for flushing.

1.4 CLOSEOUT SUBMITTALS

.1 Include:

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

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.5 DELIVERY, STORAGE AND HANDLING

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

.2 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 specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CSA B125.3.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: as indicated.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

.7 Water closets:

.1 WC-1: floor-mounted, flush tank.

.1 One piece dual flush, vitreous china, elongated bowl, shrouded bowl, power wash flushing system rated at 4.1L/6L flush, elongated front bowl, 380mm seat height, chrome push button, smooth, 54mm trap diameter, 300 mm rough-in, 75 mm flush valve seal, white finish.

.2 Approvals:

.1 Meets and exceeds ASME A112.19.2/CSA B45.1

.3 Acceptable Material: American Standard Cadet Pro 215CA.004 , Kohler, Toto

.4 Seat: heavy duty, metal fasteners soft close closed front with lid, white finish

.5 Fixture supplies: flexible stainless steel finish hose, 304ss jacket, reinforced PVC inner hose, chrome plated 1/4 turn ball valve angle stops, 13 mm I.D., escutcheon, working pressure to 8.6 bar.

.2 WC-2: Floor mounted, flush tank, barrier free.

.1 ADA compliant, two-piece, close coupled, vitreous china, high efficiency water conservation and flush action, elongated front bowl, 419mm bowl height, low consumption 4.8 L flush, chrome trip type lever, smooth 54mm trap diameter, 300 mm roughin, white finish.

.2 Approvals:

.1 Meets and exceeds ASME A112.19.2/CSA B45.1

.2 EPA water sense.

.3 ADA, CSA B651 and CSA 2012.

.3 Trip lever: hand as required.

.4 MAP Performance: 1000g

.5 Acceptable Material: American Standard Cadet Pro Right Height 215AA.104, Kohler, Toto

.6 Seat: heavy duty solid plastic, slide off hinge, metal fasteners and hinge pins, open front with lid, white.

.7 Fixture supplies: flexible stainless steel finish hose, 304ss jacket, reinforced PVC inner hose, chrome plated 1/4 turn ball valve angle stops, 13 mm I.D., escutcheon, working pressure to 8.6 bar.

Part 3 Execution

3.1 INSTALLATION

.1 Install each fixture with its own trap where not integral to the fixture, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures and equipment

.2 Provide chrome plated rigid or flexible supplies to fixtures with screw driver stops, reducers and escutcheons.

.3 Caulk gap between water closet, and wall or floor with silicone sealant. Coordinate sealant colour with Architect

3.2 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Adjust flush valves to suit actual site conditions.

.4 Adjust urinal flush timing mechanisms.

.3 Checks:

.1 Water closets: flushing action.

.2 Aerators: operation, cleanliness.

.3 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls:

.1 Verify temperature settings, operation of control, limit and safety controls.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 CSA Group (CSA)

.1 CAN/CSA-B45 Series-02 (2013), Plumbing Fixtures.

.2 CAN/CSA-B125.3-12, Plumbing Fittings.

.3 CAN/CSA-B651-16, Accessible Design for the Built Environment.

.3 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

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 fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

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

.2 Include:

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

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section01 61 00 - Common Product Requirements.

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

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: architectural drawings to govern.

.5 Fixtures to be product of one manufacturer.

.6 Trim to be product of one manufacturer.

.7 Fixture piping:

.1 Hot and cold water supplies to each fixture:

.1 Chrome plated flexible supply pipes each with handwheel stop, reducers, escutcheon.

.2 Waste:

.1 Brass P trap with clean out on each fixture not having integral trap.

.2 Chrome plated in all exposed places.

2.2 STAINLESS STEEL COUNTER TOP SINKS

.1 SK-1 : double compartment, ledge back:

.1 From 20 ga thick 18-8 stainless steel, self-rimming, undercoated, clamps, 200mm centers (100mm center to center). Outside dimensions: 850 x 560 x 200 mm.

.2 Trim: chrome plated brass, with swing spout, 200mm centers, vandal resistant aerator, single lever handle, washerless controls, ADA approved, high temp limit stop, accessories to limit maximum flow rate to 5.7 litres/minute at 413 kPa.

.3 Waste fitting: 89mm waste fitting, integral stainless steel basket strainer, and plaster trap, see Section 22 05 15.

.4 Standard of Acceptance: Kindred QDLA2233-8-3, Franke, Elkay with Delta 100LF-HDF, Moen, Chicago.

.2 SK-2 : double compartment, ledge back, ADA:

.1 From 22 ga thick 18-8 stainless steel, self-rimming, undercoated, clamps, 200mm centers (100mm center to center). Outside dimensions: 840 x 560 x 150 mm.

.2 Trim: chrome plated brass, with swing spout, 200mm centers, vandal resistant aerator, single lever handle, washerless controls, ADA approved, high temp limit stop, accessories to limit maximum flow rate to 5.7 litres/minute at 413 kPa.

.3 Waste fitting: 89mm waste fitting, integral stainless steel basket strainer, and plaster trap, see Section 22 05 15.

.4 Standard of Acceptance: Kindred CDLA2233-6-3, Franke, Elkay with Delta 100LF-HDF, Moen, Chicago.

2.3 WASHROOM LAVATORIES

.1 LAV-1 :

.1 Bowl:

.1 Counter top, self rimming, oval, vitreous china, faucet ledge, centre hole, barrier free.

.2 Colour: white.

.3 Size: bowl 518mm W x 441mm front to back x 178mm depth.

.4 Approvals: CSA B45.1, NPC, ANSI A117.1

.5 Acceptable material: American Standard Aqualyn 0475.047, Kohler, Crane.

.2 Faucet:

.1 Lever handle, lead free, 100deg arc temperature operation, all metal construction with polished chrome finish, pop up waste assembly, pressure compensating single lever cartridge, 4.5 L/min flow at 413kPa.

.2 Approvals: ADA compliant, CSA B125.1.

.3 Delta 583LF-WF, Moen, Chicago

.3 Drain:

.1 32dia chrome plated, p trap with union.

.2 ADA installations to be with offset trap to achieved required clearances as per CSA-B651

.4 Fixture Supplies

.1 Chrome plated, 1/4 turn ball valve angle stops, 13 mm I.D. Inlet, escutcheon and flexible stainless steel hose risers.

2.4 FIXTURE PIPING

.1 Hot and cold water supplies to each fixture:

.1 Chrome plated flexible supply pipes each with handwheel stop, reducers, escutcheon.

.2 Waste:

.1 Brass P trap with clean out on each fixture not having integral trap.

.2 Chrome plated in all exposed places. ABS accetpable where concealed.

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 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

.2 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA-B651.

3.3 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks:

.1 Aerators: operation, cleanliness.

.2 Vacuum breakers, backflow preventers: operation under all conditions.

.3 Wash fountains: operation of flow-actuating devices.

.4 Thermostatic controls:

.1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 CSA Group (CSA)

.1 CAN/CSA-B45 Series-02 (R2013), Plumbing Fixtures.

.2 CAN/CSA-B125.3-18, Plumbing Fittings.

.3 CAN/CSA-B651-18, Accessible Design for the Built Environment.

.3 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

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 fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.

.2 Include:

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

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section01 61 00 - Common Product Requirements.

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

Part 2 Products

2.1 GENERAL REQUIREMENTS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: architectural drawings to govern.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

.7 Baths:

.1 BT-1:

.1 Tub/Shower:

.1 Approvals: CSA B125.1, NPC.

.2 Molded bath/shower unit with backsplash, chip resistant high gloss gel coat finish, FRP, moulded non slip floor pattern, lumbar support backrest, upper and lower toiletry shelves, acrylic grip rail, extended apron.

.3 Drain hand: see plans, as required.

.4 Size: 1518mm L x 883mm W x 1994mm H, overflow capacity 191 L.

.5 Colour: white.

.6 Acceptable material: Hytec 6032/3, Maxx, Ella

.2 Valve and Trim

.1 ADA compliant, single lever, pressure balancing, adjustable temperature limit stop, temperature indicator escutcheon with shower head and arm.

.2 Valve: single lever with 270deg operating arc, non metallic / non ferrous stainless steel pressure balancing cartridge with 2degC temperature range control, metal construction, chrome finish.

.3 Shower Head: 5.7 L/min flow at 550 kPa, angle arm, 95mm adjustable shower head.

.4 Spout: diverter, polished finished chrome

.5 Approvals: CSA B-152.1, ASME A112.19.1.

.6 Acceptable material: Delta 13420 H20T, Moen, Chicago

.8 Showers

.1 SH-1: One piece base and Surround:

.1 Approvals: CSA B45.1, NPC, ADA.

.2 Gelcoat construction with fiberglass backing, low ADA threshold, integral tiling flange and centered drain connection.

.3 Size: overall 1588mm L x 991mm W x 1991mm H

.4 Colour: white.

.5 Acceptable material: Hytec 6236L/R, Maxx, Ella

.2 Valve and Trim

.1 Head:

.1 Coordinate location with Architectural

.2 Fixed shower head, side wall mounted, fixed arm, 5.7 l/minute at 550 kPa.

.3 Handheld head, end wall mounted, moulded plastic, non-clog, with adjustable spray, pause, button, dual check valves, stainless steel flexible hose and escutcheon, 915mm stainless steel grab bar. Limit maximum flow rate to 5.7 l/minute at 550 kPa.

.2 Diverter Handle; wall mounted, leaver operated, ADA compliant.

.3 Rough in; Heavy duty brass body, Pressure-balanced-actuated element, field adjustable hot water zone, limit stops strainer and check-stops on each inlet, lever handle, CSA certified, ADA approved.

.4 Approvals: CSA B-152.1, ASME A112.19.1.

.5 Acceptable Material: Delta T13H332 with R10700-UNWS rough in, Moen, Chicago

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 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

.2 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA B651.

3.3 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks:

.1 Aerators: operation, cleanliness.

.2 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls:

.1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This section covers items common to all sections of Division 21, 22, and 23 and is intended to supplement the requirements of Division 1

.2 When reference is made to Codes and Standards in these specifications, the most recent edition of the Code or Standard to be used

1.2 SCOPE OF WORK

.1 Provide a complete, fully tested and operational mechanical system to meet the requirements described herein, in complete accordance with the applicable codes and ordinances.

.2 The word “Provide” shall mean “Supply and Install” the products and services specified. “As Indicated” means that the item(s) specified are shown on the drawings.

.3 Provide materials and equipment in conformance with the specified design, performance and quality. Equipment shall have published certifications and shall have replacement parts readily available.

.4 Follow manufacturers recommended installation details and procedures for equipment supplemented by the requirements of the contractor documents.

.5 The most stringent requirements of this and other mechanical sections shall govern. Should inconsistencies exist, the more stringent requirement shall apply.

.6 Provide seismic restraint for all equipment as specified.

.7 Connect to equipment specified in other Sections and to equipment supplied and installed by other contractors or by Owner.

1.3 MATERIALS

.1 Standard of Acceptance means that item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

.2 Equipment and material shall be installed and tested in accordance with the detailed recommendations of the manufacturer. Where there is a discrepancy between the drawings and/or the specifications and the manufacturer's written installation instructions, the most stringent shall be followed.

.3 All materials shall be CSA certified.

1.4 SUBSTITUTIONS

.1 No substitutions shall be permitted without prior written approval of Owner's Representative.

.2 Proposals for substitution may only be submitted up to 7 working days prior to tender closing. Proposals after award of contract must include statements of respective costs of items originally specified and the proposed substitution.

.3 Proposals after award of contract will be considered by Owner's Representative if:

.1 materials selected by tenderer from those specified are not available;

.2 delivery date of materials selected from those specified would unduly delay completion of contract; or

.3 alternative material to those specified, which are brought to the attention of and considered by Owner's Representative as equivalent to the material specified and will result in a credit to the Contract amount.

.4 Should proposed substitution be accepted, either in part or in whole, assume full responsibility and costs when substitution affects other work on project. Pay for design or drawing changes required as result of substitution.

.5 Amounts of all credits arising from approval of substitutions will be determined by Owner's Representative and Contract Price will be reduced accordingly.

1.5 INTENT

.1 Work shall be in accordance with the specifications and their complete with all necessary components, including those not normally shown or called for, and ready for operation before acceptance.

1.6 RESPONSIBILITY

.1 Promptly advise the Owner of any specified equipment and/or material which appears inadequate or unsuitable; in violation of laws, ordinances, rules, or regulation of authorities having jurisdiction; of any necessary items of work omitted from the Contract Documents; or of any discrepancies in the Specification.

.2 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra costs to the Owner without the Owner's written approval.

.3 Ensure that equipment does not transmit noise and/or vibration to other parts of the building as a result of poor installation practice.

.4 During freezing weather, protect all materials in such a manner that no harm can be done to installations already in place. Schedule work as required.

.5 Pay for permits required by the Authority Having Jurisdiction. Arrange for applicable inspections.

1.7 WORKMANSHIP

.1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by Departmental Representative and the Trade.

.2 The Owner shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish, and appearance.

.3 Employ only tradesmen holding valid Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

.4 On request by the Departmental Representative, the Contractor shall demonstrate thorough knowledge of system and equipment being installed.

1.8 SCHEDULING

.1 Coordinate with Division 1 Construction Schedule.

.2 Incorporate into the Construction Schedule, a complete and realistic schedule, intergrated with and recognizing the reliance on, other trades. Take into account lead times for delivery, review, installation, and start-up.

1.9 DRAWINGS AND SPECIFICATIONS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Do not scale the drawings.

.2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representativewhere definite locations are not indicated.

.3 Take field measurements where equipment and material dimensions are dependent upon building dimensions.

.4 The drawings and specifications are complimentary to each other, and what is called for in one shall be binding as if called for in both.

.5 Should any discrepancy between the drawings and specifications be present, it is the responsibility of the contractor to notify the Departmental Representative prior to the closing of the tender. If not done, it will be assumed that the contractor has allowed for the most expensive option.

1.10 EQUIPMENT INSTALLATION

.1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.

.2 Provide means of access for servicing, disassembly, and removal of equipment and components including permanently lubricated bearings.

.3 Pipe equipment drains to floor drains.

.4 Line up equipment, rectangular cleanouts and similar items parallel to or perpendicular to building walls.

.5 Flexible couplings: Install to provide for differential movement during seismic events between attachment points.

.6 Expansion joints: Install on any straight run of heating pipe longer than 100 feet (30m).

1.11 PROTECTION OF OPENINGS

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

1.12 ELECTRICAL

.1 Electrical work is to conform to Division 26 specifications. The following electrical work is included in Division 25.

.1 All conduit, wiring, and connections 50V and under relating to mechanical systems including installation of transformers. Refer to Division 26 for further clarification.

1.13 TESTS

.1 Give 72 hours notice of date for tests, during regular working hours.

.2 Insulate or conceal work only after testing and approval by Departmental Representative.

.3 Conduct tests in presence of Departmental Representative.

.4 Bear costs, including heating cost, for all testing under this division and Division 26, retesting, and making good.

.5 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.14 DEMONSTRATION AND OPERATING & MAINTENANCE INSTRUCTIONS

.1 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.

.2 Conduct to the requirements of Division 1.

.3 Use Operation and Maintenance Manual and record drawings as part of instruction materials.

.4 Operating personnel shall be contacted at the beginning of the project and encouraged to come on site at least once a week for the duration of the project. During these periods, they shall be given full explanation of the various systems as the project progresses.

.5 Two weeks prior to substantial inspection, the mechanical contractor, along with the sub trades, are expected to provide two half-day training sessions for the building owners and staff. The contractors are expected to be available during the warranty period to answer questions and troubleshoot problems.

.6 Maintain log of all site visits by operating personnel. Operating personnel to login/out and be witnessed by Contractor. Provide log as requested.

1.15 PAINTING

.1 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

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

.3 Restore to new condition finishes which have been damaged too extensively to be merely primed and touched up.

1.16 EQUIPMENT SUPPORTS

.1 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of Seismic Engineer.

.2 Mount base mounted equipment on housekeeping pads provided by General Contractor where indicated on the drawings.

1.17 FIELD REVIEWS

.1 Provide for mechanical job foreman and representatives of all applicable mechanical sub-trades to be on site and available during periodic field reviews by Consultant.

.2 Provide materials to Consultant as required to assist with field reviews, including but not limited to, drawings, specifications, scales, tape measures, ladders, lights, etc..

.3 Notify Departmental Representative in writing prior to all boarding or wall covering of the mechanical rough-in.

.4 Notification is to be at least 4 days prior to actual site visit time.

.5 The Mechanical Contractor is to ensure that all components of the installation are accessible or furnish accessibility as required by the Consultant or Departmental Representative.

.6 Take digital photographs before concealing any mechanical equipment, either underground or within walls, and submit on CD or via email as part of record documents.

1.18 START-UP

.1 The Mechanical Contractor is responsible for coordinating with sub-trades, and shall ensure the equipment and systems are prepared, cleaned, adjusted, with start-up completed, and verified in accordance with the TAB specification section and meet requirements thereof prior to commencement by balancer. Schedule TAB work following the completion of the following items:

.2 Installation of ceilings, doors, windows, and other construction affecting TAB.

.3 Application of sealing, caulking, and weather-stripping.

.4 All provisions of TAB are installed and operational.

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

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

.2 Filters in place and in clean condition.

.3 Duct systems clean of debris.

.4 Air shafts and ceiling plenums are airtight to within specified tolerances.

.5 Correct fan rotation.

.6 Coil fins cleaned and combed.

.7 Access doors closed and duct end caps in place.

.8 All outlets installed and connected.

.9 Isolation valves are open.

.10 Control valves are connected, powered and operating,

.6 Resolve issues noted by balancer for completion of TAB work.

.7 Complete start-up work as described in TAB procedures and as described in the individual sections of Div. 21, 22, and 23. Both Mechanical Contractor and Controls Sub-contractor are responsible for being present during start-up.

.8 Provide start-up reports for each piece of equipment and system as required by manufacturer and the requirements of this section.

.9 Start-up and TAB completion required prior to issue of certificate of Substantial Performance.

1.19 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 as indicated in the individual Sections of Div. 21, 22, and 23.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 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.

.3 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.

1.20 CLOSE-OUT REQUIREMENTS

.1 The project close-out requirements are specifically listed in each section of the specification. The following is a summary of those requirements. Refer to detailed sections for further requirements. All life safety systems must be operational, tested with verification reports submitted prior to substantial completion.

.1 General:

.1 Identification Schedules

.2 Training and Demonstration signed off by Owner

.3 List of incomplete or deficient work prepared and signed by each sub-trade

.4 List of Spare Parts signed off by owner

.5 Letter or Guarantee and Warranty

.6 Operation and Maintenance Manuals

.2 Heating:

.1 Oil fired appliance, line and piping certificates.

.2 Pressure test reports

.3 As-built drawings

.4 Flushing and cleaning report

.5 Oil fired appliance start-up and commissioning reports

.6 Testing, Adjusting and Balancing Report

.7 Manufacturers start-up reports

.3 HVAC

.1 As-built drawings

.2 Testing, Adjusting and Balancing Report

.4 Controls

.1 Controls system completion report with check sheets

.2 Control system final electrical approval certificate.

.3 As-built control drawings

.4 Controls training signed off by owner.

.5 Control system database, digital format.

1.21 SUBSTANTIAL PERFORMANCE REQUIREMENTS

.1 Before Consultant is requested to make an inspection for substantial performance of the work;

.1 Commission all systems and prove out all components, interlocks and safety devices.

.2 Submit a letter certifying that all work, including calibration, testing, adjusting and balancing of systems, is complete, operational, clean and all required submissions have been completed.

.3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Consultant, this list indicates that the project is excessively incomplete, substantial will be delayed until more progress is made.

.2 The work will not be considered to be ready for substantial completion until the following requirements have been met;

.1 All reported deficiencies have been corrected.

.2 Testing and balancing have been completed and report submitted.

.3 Operating and Maintenance Manual have been completed and submitted.

.4 “As-built” drawings have been completed and submitted.

.5 System Start-up has been completed and verified to the satisfaction of the Departmental Representative

.6 All demonstrations to the owner have been completed.

.3 Letter of Assurance will not be issued until the following requirements have been completed;

.1 Project is considered substantially completed as indicated above.

.2 Oil System Inspection and Final

.3 Plumbing Inspection Final

.4 Records of all tests have been submitted

.5 Testing, Adjusting and Balancing Report

.6 Seismic Letter of Assurance and final inspection

.7 Life safety systems have been verified in accordance with the relevant sections of this specification.

.8 Bacteriological Test Report

.9 Chlorination Report

1.22 OPERATION AND MAINTENANCE MANUALS

.1 Submit in accordance with Section 01 78 00- Closeout Submittals .

.2 Shall be the responsibility of the Mechanical Contractor.

.3 Provide an organized compilation of operating and maintenance data including detailed technical information, documents, and records describing products as specified below, and in individual sections of this division and Division 1.

.4 Operation and maintenance manual to be approved by, and final copies deposited with, Departmental Representative before final inspection.

.5 In addition to number of required sets specified in Division 1 for turn over to the Owner, provide 1 additional complete and accurate PDF electronic copy on a USB flash drive to the Departmental Representative and Owner.

.6 In addition to specific requirements of individual Division 21, 22, & 23 Sections, include:

.1 Title page listing submittal date, project title, name and address of Contractor and all Subcontractors.

.2 Table of contents.

.3 Warranties and guaranties.

.4 Copies of approvals and certificates.

.5 List of equipment including suppliers, location, designation, and nameplate data.

.6 Colour coding chart for identification.

.7 Valve Tag Schedule

.8 Copies of all final “reviewed” shop drawings

.9 Copies of all tests and certificates.

.10 Building potable water system disinfection approvals from Environmental Health.

.11 Reduced photocopy of record drawings at 279 mm x 432 mm size.

.12 Completed controls as-built documentation, and copy of control panel connection diagrams and schematics included inside the control panels. Programming software on CD including full electronic print-out complete with programmers comments. Hard copy print-out of point summary, alarm summary, switching tables, and control strategy inclusive of programmers comments.

.13 Complete set of seismic construction documents showing "as-built" conditions.

.14 Photographic record CD.

.7 Operation data to include:

.1 Control schematics for each system including environmental controls.

.2 Description of each system and its controls.

.3 Operation instruction for each system and each component.

.4 Description of operation of each system at various loads together with reset schedules and seasonal variances.

.5 Description of actions to be taken in event of equipment failure.

.8 Maintenance data shall include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment tabulated into a single summarizing document.

.2 Maintenance Schedules shall detail preventative maintenance procedures and their required
frequency.

.3 Maintenance Schedules of tasks shall be subdivided into daily, weekly, bi-monthly, monthly, bi-annual, annual, 5 year, 10 year, etc. tasks as required.

.9 Performance data to include:

.1 Equipment manufacturer's performance data sheets with point of operation as left after TAB is complete.

.2 Equipment performance test results.

.3 Testing, adjusting and balancing reports as specified in Section 25 05 93- Testing, Adjusting, and Balancing.

.10 Equipment data to include:

.1 Copies of reviewed shop drawings bearing Contractor's stamp of approval and Consultant's review stamp. Photocopies are acceptable. Include details of suppliers.

.11 Approvals:

.1 Submit 1 copy of draft Operation and Maintenance Manual to Departmental Representative for approval.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.3 After receiving approval of the draft copy, make any corrections as may be required and then furnish three final copies to the Departmental Representative at least ten working days prior to the substantial performance inspection date.

.12 Additional data:

.1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

.13 Site records:

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

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

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.14 As-built drawings:

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

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

.3 Submit to Departmental Representative for approval and make corrections as directed.

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

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

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

.15 Digital Copies;

.1 Digital Manuals shall be supplied on USB Thumb drives in digital format. Information shall be organized into sections in a user friendly format that easily searchable for specific information. An indexing system shall be included that remains on an expandable portion of the screen and allows end user to scroll through the manual information that appears on the main portion of the screen . The digital copy shall be arranged in a manner identical to the hard copy version. The specific requirements are listed below;

.1 Utilize Adobe Acrobat 2017 or later in PDF format.

.2 Indication manual volume where applicable.

.3 Final copies to be transferred to digital media with custom label.

.4 Label shall include project name, location, date, and information required on hard copy cover.

.5 The digital manual shall be enhanced with the following features, bookmarks, internet links, internal document links and searchable.

.16 Binders:

.1 O&M manuals to be assembled in 210x275mm capacity, expanding spine catalogue binders complete with plated piano hinges, bound in heavy fabric, hot stamped lettering on front and side. Provide sufficient volume to allow each binder to hold system data while in full closed position (not expanded). Provide artwork and fabric colour to Departmental Representative for approval prior to binder construction.

.17 Binder cover identification will include:

.1 MECHANICAL OPERATION and MAINTENANCE MANUAL

.2 BUILDING:

.3 DATE:

.4 LOCATION:

.5 OWNER:

.6 MECHANICAL ENGINEER:

.7 MECHANICAL CONTRACTOR:

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 00 - Interior Painting.

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

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

3.2 SYSTEM CLEANING

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

3.3 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

.2 Related Requirements

- .1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

- .1 ASHRAE 90.1-19, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.3 Electrical Equipment Manufacturers' Association Council (EEMAC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

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

- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
  - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

.4 Closeout Submittals

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

1.4 QUALITY ASSURANCE

.1 Motors shall be ULC listed and/or CSA certified.

.2 Full Voltage Start Applications;

.1 All motors shall be in accordance with NEMA standard and CSA C390. Motors shall comply with the applicable portions of the Canadian Electrical Code

.2 Variable Frequency Drive and Soft Start

.1 All motors shall be in accordance with NEMA standards, Part 31 and inverter duty class. Motors shall comply with the applicable portions of the Canadian Electrical Code

.2 Motors shall be wound using inverter spike resistant magnet wire capable of 1600V.

.3 The noise level of each motor shall comply with NEMA standards and shall be less than 80dBa at 1 meter.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

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: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 All motors will be rated for a 1.15 service factor in a 40C ambient environment.

.4 Provide all motors with terminal boxes, suitable for power connections.

.5 Provide screw adjustable bases on all belt-connected motors.

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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 Canadian General Standards Board (CGSB)

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

.3 CSA Group (CSA)

.1 CAN/CSA B139-19, Installation Code for Oil Burning Equipment.

.2 CSA B214, Installation Code for Hydronic Heating Systems.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-11-2015 Edition 3.2, Environmental Standard for Paints and Coatings.

.5 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada (NPC)

.2 National Fire Code of Canada 2015 (NFC).

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

.1 SCAQMD Rule 1113-2016, Architectural Coatings.

.2 SCAQMD Rule 1168-2017, Adhesive and Sealant Applications.

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, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements:

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

Part 2 Products - Not Used

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 Where connections are made between disimilar metals, provide dielectic protection through the use of dielectic unions.

3.3 CLEARANCES

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

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

3.4 DRAINS

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

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

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

.1 Discharge to be visible.

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

3.5 AIR VENTS

.1 Install manual air vents to at high points.

.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 CAN/CSA B149.1, National Plumbing code of Canada and CSA-B214 as applicable.

.2 Protect openings against entry of foreign material.

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

.4 Assemble piping using fittings manufactured to ANSI standards.

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

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

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

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

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

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

.10 Group piping wherever possible and as indicated.

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

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

.13 Provide for thermal expansion as indicated.

.14 Valves:

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above horizontal position unless indicated.
- .4 Valves accessible for maintenance without removing adjacent piping.
- .5 Install globe valves in bypass around control valves.
- .6 Use ball valves at branch take-offs for isolating purposes except where specified.
- .7 Install ball valves for glycol service.

.15 Check Valves:

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

3.8 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.

3.9 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush system in accordance with Section 23 08 16 - Cleaning and start-up of HVAC piping systems.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 00 - Cleaning supplemented as specified in relevant mechanical sections.

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

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise 72 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 Departmental Representative.

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

.7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100-2013, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008(2013), Thermometers, Direct Reading and Remote Reading.

.3 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.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-21, Standard for Paints and Coatings.

.2 GS-36-13(R2021), Standard for Commercial Adhesives.

1.3 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.

.3 Certificates:

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

.4 Test and Evaluation Reports:

.1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

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

.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 thermometers and pressure gauges in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

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

.2 Ranges: as indicated.

2.2 DIRECT READING THERMOMETERS

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

.1 Resistance to shock and vibration.

.2 Refer to flow schematics for location of pipe mounted thermostat and wells.

.3 Case: Cast aluminium alloy, coated with baked enamel. Clear heat resistant plastic window or glass.

.4 White background with temperature range in black. Celsius Scale.

.5 Acceptable Manufacturers: Winters, Weiss, Moeller

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass, separable socket, 3/4" NPT.

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.

.1 1/4" NPT.

.2 Case – Cast aluminium, black enamel steel or stainless steel with chrome-plated face ring.

.3 White background with pressure range in black. Dual kPa and psig scale.

.4 Acceptable Manufacturers: Winters, Weiss, Moeller

.5 Provide:

.1 Snubber for pulsating operation.

.2 Bronze stop cock.

.3 Oil filled for high vibration applications.

2.5 TEST PLUGS

.1 ¼ NPT solid brass test plug fitting with brass chain.

.2 Capable of receiving either pressure or temperature, dual seal core, rated to 175°C and zero leakage at 1000 psi vacuum.

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 heating and cooling coils.

.3 Water boilers.

.4 DHW tanks.

.3 Install wells as indicated only for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in locations as follows:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of PRV's.

.3 Upstream and downstream of control valves.

.4 Inlet and outlet of coils.

.5 Inlet and outlet of liquid side of heat exchangers.

.6 Outlet of boilers.

.7 In other locations as indicated.

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

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

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates in accordance with Section 23 05 53 - Identification For HVAC Piping and Equipment, identifying medium.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by thermometer and gauge installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.1 ANSI/ASME B1.20.1-2013 (R2018), Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18-2018, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASTM International (ASTM)

.1 ASTM A276-17, Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283-20, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M-18, Standard Specification for Copper-Base Alloy Continuous Castings.

.4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS-SP-25-2018, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80-2019, Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

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 equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit data for valves specified in this Section.

1.4 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 MATERIALS

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: solder ends to ANSI/ASME B16.18.

.3 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: screwed with hexagonal shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.4 Silent Check Valves:

.1 NPS 2 and under:

.1 Body: cast high tensile bronze to ASTM B62 with integral seat.

.2 Pressure rating: Class 125.

.3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.

.4 Disc and seat: renewable rotating disc.

.5 Stainless steel spring, heavy duty.

.6 Seat: regrindable.

.5 Ball Valves:

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class125, 860 kPa steam.

.3 Connections: to suit piping material.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.6 Drain Valves:

.1 Drain Valves up to 50 mm: Forged brass body, brass cap, stem, and ball. Teflon stem seals and Teflon seat. Hose thread end. Working pressure 1725 kPa at 121°C.

.2 Drain Valves 65 mm and Over: Bronze body, bronze ball, threaded ends, twin seal Teflon seats and Viton seals, "O" ring, lever handle, rating 2070 kPa at 121°C water.

.7 DHW Circuit Balancing Valve

.1 Circuit Balancing Valves: Suitable for throttling on DHW pumps only. All metal parts non-ferrous, die cast non porous copper alloy. Flow measuring accuracy ±2%. Positive shut-off, drain connection with cap. Memory balancing feature. Fittings for connection of portable differential pressure meter.

.8 Strainers

.1 Size 50 mm and under: Screwed brass, Y pattern with 0.75 mm stainless steel perforated screen.

Part 3 Execution

3.1 APPLICATION

.1 Provide valves as indicated on the drainings and as outlined in the following schedule:

.1 Swing Check Valves:

.1 Discharge of Pumps

.2 Spring Loaded Check Valves

.1 Pump Discharge, vertical Installation

.3 Drain Valves

.1 Near main shut-off valves

.2 Low points in piping systems

.3 bases of vertical risers

.4 At equipment

.4 Ball Valves

.1 Shut-off and isolation

.2 Isolating Service

.3 Domestic Water (hot and cold)

.4 Drain Valves

.5 Glycol Systems

3.2 INSTALLATION

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

.2 Remove internal parts before soldering.

.3 Install valves for shut-off and isolating service, to isolate all equipment, parts of systems, or vertical risers

.4 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.

.5 Size drain lines and drain valves equal to size of apparatus drain connection. For pipe sizes 20 mm and over, minimum drain size to be 20 mm. Provide hose thread connection with cap and chain for 20 mm drain valves located in ceiling and public areas.

.6 Provide male NPT nipples with threaded pipe cap for drain sizes over 20 mm where not piped directly to floor drains.

.7 Provide valved drain and hose connection off the bottom of all strainers.

.8 Install strainer on the inlet to pumps where indicated. Use temporary screens during construction and system cleaning. Remove temporary and install permanent screens prior to system balancing.

.9 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 American Society of Mechanical Engineers (ASME)

- .1 ASME B31.1-20, Power Piping.

.3 ASTM International (ASTM)

- .1 ASTM A125-2018, Standard Specification for Steel Springs, Helical, Heat-Treated.
- .2 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 ASTM A563-21a, Standard Specification for Carbon and Alloy Steel Nuts.

.4 Factory Mutual (FM)

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

- .1 MSS SP58-2018, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .2 MSS SP69-2016, Pipe Hangers and Supports - Selection and Application.
- .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.6 National Research Council Canada (NRC)

- .1 National Plumbing Code of Canada 2015 (NPC).

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.

.3 Shop Drawings:

- .1 Submit shop drawings for:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.

1.4 CLOSEOUT SUBMITTALS

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

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 start-up. Amount of adjustment in accordance with MSS SP58.

2.2 GENERAL

.1 Provide hangers and supports to secure equipment in place, prevent vibration, protect against damage from an earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.

.2 The contractor is to engage and pay for the services of a NAPEG Registered Professional Engineer to provide all required engineering services necessary for the complete design, sizing and detailing of all anchors, anchors supports, bracing and structural attachments for the project. Submit stamped shop drawings and a Letter of Design Assurance to the requirements of the Authority Having Jurisdiction and these specifications.

.3 Set inserts in position in advance of concrete work, use a gridded system in equipment rooms.

.4 Support piping and equipment from the buildings structure unless specifically approved by the Engineer of Record. Coordinate attachment points with Structural Consultant.

.5 Hangers for copper pipe shall be copper plated or plastic dipped unless pipe hangers bear on insulation.

2.3 GENERAL

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

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

2.4 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 Attachement: Wood Joist and Decks

.1 Threaded pipe hanger, galvanized.

.3 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.

.4 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel galvanized.

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

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

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

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

.6 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.

2.5 RISER CLAMPS

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

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

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.6 EQUIPMENT SUPPORTS

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

2.7 DUCT HANGERS AND SUPPORTS

.1 As a minimum, confirm to SMACNA standards.

2.8 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of structural engineer. Submit structural calculations with shop drawings..

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

- .1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

- .1 Install on piping systems at booster pumps 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 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 EQUIPMENT BASES AND SUPPORTS

.1 All equipment to be installed and support as per manufacturers recommendation and the requirements of Part 4 of the National Building Code of Canada.

.2 Seismically restrain all equipment as indicated in Section 23 05 48 - Vibration and Seismic Controls for HVAC and as per SRS engineer direction.

3.4 DUCT SUPPORTS

.1 Support duct work in accordance with SMACNA, and as a minimum as follows.

.2 Low Pressure Duct Hangers and Supports

- .1 <u>Hanger Minimum Sizes:</u>
  - .1 Up to 750 mm wide: 25 mm x 1.6 mm at 3.0 m spacing;
- .2 <u>Horizontal Duct on Wall Supports Minimum Sizes</u>
  - .1 Up to 450 mm wide: 40 mm x 1.6 mm or 25 mm x 3 mm at 2.4 m spacing
- .3 <u>Vertical Duct on Wall Supports Minimum Sizes</u>
  - .1 At 3.6 mm spacing
  - .2 Up to 600 mm wide: 40 mm x 1.6 mm
- .4 <u>Vertical Duct Floor Supports Minimum Sizes</u>

.1 Riveted or screwed to duct

.2 Up to 1500 mm wide: 40 mm x 40 mm x 3 mm

3.5 HANGER SPACING

.1 Plumbing piping: to National Plumbing Code of Canada (NPC).

.1 At minimum support piping as follows;

.1 Piping 15 to 20 mm:

.1 Hanger: 10mm

.2 Steel: 1800mm

.3 Copper: 1500mm

.2 Piping 25 to 40 mm:

.1 Hanger: 10mm

.2 Steel: 2100mm

.3 Copper: 1800mm

.2 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

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

.4 Flexible joint roll groove pipe: in accordance with table below 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.

.5 Within 300 mm of each elbow.

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

3.6 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.

.4 Use oversize hangers to accommodate pipe insulation thickness. For pipes up to 50 mm use high density rigid pipe insulation at hanger location, with an insulation protection shield. For pipes 65 mm and over use insulation protection saddle.

.5 Place a hanger within 300 mm of each horizontal elbow.

.6 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.

.7 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

.8 Where practical, support riser piping independently of connected horizontal piping.

.9 Support plastic piping in accordance with manufacturers recommendations.

3.7 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.

3.8 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Vibration isolation materials and components, seismic control measures and their installation.

.2 Related Requirements

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.1 Material Safety Data Sheets (SDS)

.3 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

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

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

.1 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Northwest Territories, Canada.

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

.3 Provide detailed drawings of seismic control measures for equipment and piping.

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

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

.2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

Part 2 Products

2.1 GENERAL

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

.2 Provide vibration isolation on all motor driven equipment, piping, and ductwork such that the noise transmission to the occupied space by any other path then airborne is less than the airborne noise transmitted from mechanical space to occupied space. The following are considered minimum requirements to meet this criteria.

.3 Provide seismic restraint for all equipment, piping and ductwork including all seismic restraint related hardware for point of attachment to equipment through to and including the attachment
to structure.

.4 Place isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the center of gravity of the equipment.

.5 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency.

.6 Use ductile materials in all vibration and seismic restraint equipment.

.7 Provide flexible connections between equipment and piping where required by manufacturers to protect equipment from stress and reduce vibration in piping system.

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

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

2.4 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

.6 Performance: as indicated.

2.5 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

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

2.6 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.7 SEISMIC CONTROL MEASURES

.1 General:

- .1 The contractor is to engage and pay for the services of a Northwest Territories and Nuvaut (NAPEG) Registered Professional Engineer to provide all required engineering services necessary for the complete design, sizing and detailing of all anchors, anchors supports, bracing and structural attachments used for seismic restraint systems for the project. Submit stamped shop drawings and a Letter of Design Assurance to the requirements of the Authority Having Jurisdiction and these specifications.
- .2 Seismic control systems to work in every direction.
- .3 Fasteners and attachment points to resist same maximum load as seismic restraint.
- .4 Drilled or power driven anchors and fasteners not permitted.
- .5 No equipment, equipment supports or mounts to fail before failure of structure.
- .6 Supports of cast iron or threaded pipe not permitted.

.2 Static equipment:

- .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
- .2 Suspended equipment:

.1 Use one or more of following methods depending upon site conditions :

.1 Install tight to structure.

.2 Cross brace in every direction.

.3 Brace back to structure.

.4 Cable restraint system.

.3 Seismic restraints:

.1 Cushioning action gentle and steady.

.2 Never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.3 As indicated.

.4 Piping systems:

.1 Piping systems: hangers longer than 305 mm; brace at each hanger.

.2 Compatible with requirements for anchoring and guiding of piping systems.

.5 Field fabricated support structures

.1 The contractor is to engage and pay for the services of a Northwest Territories and Nuvaut (NAPEG) Registered Professional Engineer to provide all required engineering services necessary for the
complete design, sizing and detailing of all field fabricated support structures, include tank support structure including structural attachments and seismic restraint systems. Submit stamped shop drawings and a Letter of Design Assurance to the requirements of the Authority Having Jurisdiction and these specifications.

.6 Bracing methods:

.1 Approved by Seismic Engineer.

.2 Structural angles or channels.

.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

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 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

- .1 Up to NPS4: first 3 points of support.
- .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

.7 Verify loading on all isolators after adjustment

.8 Install Hanger Isolators on ceiling hung fans, pumps, silencers, and other vibrating sources. Size for minimum static deflection of 25mm.

.9 Provide floor mounts for all floor mounted pumps and fans.

.10 Where ductwork, piping or boiler exhaust stacks are connected to or servicing noise generating equipment, is run through wall, floor, chases etc. position equipment to avoid contact with structure, future framing and finishes that may radiate noise.

.11 Make no connections between mechanical equipment and drywall partitions that adjoin occupied spaces. Mount all equipment on non-critical surfaces.

.12 Ensure that flexible duct connections are installed with minimum of 50mm metal to metal gap. Use Flanges to ensure that connectors are clear of airstream.

.13 Isolate all floor mounted equipment on Rubber pads or floor mounts.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

.2 Related Requirements

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 Canadian Gas Association (CGA)

.3 Canadian General Standards Board (CGSB)

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

.2 CAN/CGSB-24.3-12, Identification of Piping Systems.

.4 National Fire Protection Association (NFPA)

1.3 ACTION AND INFORMATIONAL 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.

.2 Health and Safety:

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

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)
.2	1	10 x 50	1	3
.3	2	13 x 75	1	5
.4	3	13 x 75	2	3
.5	4	20 x 100	1	8
.6	5	20 x 100	2	5
.7	6	20 x 200	1	8
.8	7	25 x 125	1	12
.9	8	25 x 125	2	8
.10	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.

.3 Located on cool, conspicuous surfaces in plain sight. Do not insulate over labels.

.5 Equipment:

.1 Label equipment with identifiers consistent with the design documents and equipment Tags.

.2 Water Fill and Sanitary Pump out locaitons

2.3 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

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

.2 Fuel Oil: to CSA-B139 Series 19

2.4 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 Location:

.1 Within 300mm of all valves.

.2 Adjacent to changes in direction.

.3 At least once in each room and on 6m intervals on straight runs.

.4 At each access point.

.5 On either side of walls.

.6 Beginning and end points of each run and at each piece of equipment.

.6 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

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

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

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

.8 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

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

.1 **Background colour:** **Legend, arrows:**

.2	Yellow	BLACK
.3	Green	WHITE
.4	Red	WHITE

.3 Background colour marking and legends for piping systems:

.1	**Contents**	**Background colour marking**	**Legend**
.2	Glycol heating supply	Yellow	GLY. S.
.3	Glycol heating return	Yellow	GLY. R.
.4	Hot water heating supply	Yellow	H.W.S.
.5	Hot water heating return	Yellow	H.W.R.
.6	Boiler feed water	Yellow	B.F.W.
.7	Domestic hot water supply	Green	D.H.W.
.8	Dom. HWS recirculation	Green	D.H.W.R.
.9	Domestic cold water supply	Green	D.C.W
.10	Sanitary	Green	SAN S.
.11	Plumbing vent	Green	SAN. VENT
.12	Fuel Oil Supply	Orange	F.O.S
.13	Fuel Oil Return	Orange	F.O.R.

2.5 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.

.3 Identify plenum access doors as to accessed items and equipment.

.4 Identify all hazardous exhaust ducts , such as fume hoods, at no greater than 3m intervals and in each partitioned space.

2.6 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.

.3 Tag valves in the following locations;

.1 Valves on all main circuits

.2 Valves on all major branch lines

.3 Valves in minor branch circuits in services spaces.

.4 Drain valves and hose bibs on heating systems

.5 Control valves.

2.7 CONTROLS COMPONENTS IDENTIFICATION

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

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

2.8 LANGUAGE

.1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

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

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

.1 Locations:

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

.2 Standoffs:

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

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

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

.2 Adjacent to each change in direction.

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

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

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

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

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

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

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

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

3.6 VALVES, CONTROLLERS

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

.2 Number valves in each system consecutively.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 00 - 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 QUALIFICATIONS OF TAB PERSONNEL

.1 Employ an independent testing and balancing agency specializing in this work to test, adjust and balance mechanical systems installed under this contract.

.2 Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of contract.

.3 Provide documentation confirming qualifications, successful experience.

.4 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-1-2016.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2019.

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

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

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

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

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

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

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

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

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

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 RESPONSIBILITY

.1 TAB agency shall be responsible to;

.1 Ensure that all mechanical systems are complete and ready to be balanced and provide sufficient time for testing and balancing prior to substantial performance.

.2 Make corrections to achieve performance without delay, include al corrections made during the balancing procedures on “as-built drawings”. Mechanical contractor to provide as-built information to TAB agent prior to commencement of work.

.3 Adjust fan drives, and adjust speeds as required to achieve system performance.

.4 Coordinate with Controls Contractor to make adjustment to controls system to facilitate balancing.

.5 Check alignment and tension of motors and belts.

.6 Consult with the Departmental Representative to clarify design intent where necessary.

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 confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

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

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

1.8 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 Departmental Representative for verification of TAB reports.

1.10 START OF TAB

.1 Notify Departmental Representative 7 days prior to start of TAB.

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

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

.2 Application of weatherstripping, sealing, and caulking.

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

.4 Provisions for TAB installed and operational.

.3 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 Correct fan rotation.

.4 Coil fins combed, clean.

.5 Access doors, installed, closed.

.6 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 Other HVAC systems: plus 10 %, minus 5 %.

.2 Hydronic systems: plus or minus 10 %.

1.12 INSTRUMENTS

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

.2 Calibrate within 12 months of TAB. Provide certificate of calibration with TAB report □□□□.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit, prior to commencement of TAB:

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

1.14 PRELIMINARY TAB REPORT

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

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

.5 Formats for sheets.

1.15 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Field notes to clearly identify unusual conditions or issues affecting TAB.

.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, pump, terminal unit, heating element, 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).

.3 Submit digital copy of report for review

1.16 SETTINGS

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

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

.3 Set and lock all memory stop balancing devices and record value in TAB report.

.4 Seal all holes with snap plugs at completion of TAB

1.17 COMPLETION OF TAB

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

.2 Repair any damages to finishes cause by performance of TAB.

1.18 AIR SYSTEMS

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

.2 Do TAB of following systems, equipment, components, and associated controls:

.1 Adjust duct and terminal balance dampers and adjust or change drive sheaves and.

.2 Use terminal balance dampers to regulate air quantities only to the extent that.

.3 Measure air quantities at each air terminal under eas operating condition. Confirm operation of air flow valves as per specification.

.4 Maintain the design relationship between the supply and exhaust air system quantities.

.5 Adjust air terminals to obtain optimum air distribution in the space.

.6 Verify that room thermostats are cycling valves and mixing boxes. Coordinate with Div. 23 to rectify any issues.

.7 Check room pressurization to ensure air in or out of room in in the correct directions.

.8 Indicate in report;

.1 Time and date of testing

.2 Outdoor air temperatures during testing

.3 Outdoor air quantities.

.4 Mortor size, amps, and voltage.

.5 Coil entering air and leaving air temperatures and pressure drop.

.6 Maximum and minimum zone supply air flows.

.7 Fan performance curves for each air handling system.

.3 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.

.4 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.

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

1.19 LIQUID SYSTEMS

.1 Set balancing valve and fittings to provide the required or design flow rates for each system component.

.2 Use installed flow measuring devices to determine flow rates for system balance. Where flow measuring devices are not installed, base flow balance on measured values.

.3 Effect system balance with automatic control valves fully open to heat transfer elements.

.4 Check air vents to ensure that they are correctly installed and operating. The mechanical contractor shall ensure all air is removed prior to commencement of balancing.

.5 Include in the liquid balance report;

.1 Date and time of testing

.2 Outdoor air temperatures during testing.

.3 Pumps: tag, service, location, manufacturer, model size. Specified and actual flows and head pressure.

.4 Motor information including operating speed, amps and voltage.

.5 Heat exchangers, Tag, service, location, manufacturer, model, and size. Specified and actual capacity, liquid flow rates on both side of heat exchanger, inlet and outlet temperatures and pressure.

.6 Heating Coils; Tag, service, location, size. Specified and actual capacity, flow, pressure drop, entering and leaving fluid temperatures, air-side entering and leaving temperatures.

.7 Flow measuring devices: Flow rates.

.8 Terminal heating units: Zone design and actual flow rates, entering and leaving temperatures.

.9 Systems schematics based on ‘as-builts” with specified and actual flow rates.

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 REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.1 ANSI/ASHRAE/IESNA 90.1-19, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.3 ASTM International (ASTM)

.1 ASTM B209M-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335-17, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411-19, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-2019, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-19, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-13(2019), Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-14(2019), Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-08(2018), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.4 Canadian General Standards Board (CGSB)

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

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

.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-18, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-1:2017, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 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 previouslydefined.

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

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

1.4 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.

1.5 QUALITY ASSURANCE

.1 Qualifications:

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

1.6 DELIVERY, STORAGE AND HANDLING

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

.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 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

.3 ULC listed for use in non-combustible construction

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).

.1 Glass fibre: to ASTM C553.

.2 Maximum "k" factor: 0.0409 W/(m.C) to ASTM C553.

2.3 JACKETS

.1 Canvas:

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

.2 Lagging adhesive: compatible with insulation.

2.4 ACCESSORIES

.1 General: ULC labeled for less than 25 flame spread and less than 50 smoke developed.

.2 Vapour retarder lap adhesive:

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

.3 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m^2cotton, 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: 19 mm wide, 0.5 mm thick stainless steel.

.11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face.

.12 Fasteners: 4 mm diameter pins with35 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 Apply insulation and jacketing in a clean workmanlike manner so that the finished product is uniform, smooth in finish and pleasing to the eye with longitudinal seams concealed from view.

.2 Terminate insulation short of all control, smoke and fire dampers so as to not interfere with their operation.

.3 Install in accordance with TIAC National Standards.

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

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

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

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

.7 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.

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

3.4 EXTERNAL FLEXIBLE INSULATION WITH VAPOR BARRIER

.1 Install insulation with insulation adhesive applied in 150mm wide strips on 300 mm centers.

.2 On rectangular ductwork over 610mm in width, spotweld pins 6mm longer than insulation thickness, one per square foot minimum. Impale insulation over pins and hold in place using metal or nylon clips.

.3 Adhere foil faced vapour barrier tape over butt joints, raw edges, washers and other points of penetration of the vapour barrier jacket.

3.5 INTERNAL FLEXIBLE DUCT LINER APPLICATION

.1 Adhere insulation with insulation adhesive applied to the whole metal surface with the coating side of the insulation exposed to the airstream.

.2 Ducts 610mm in width and less require no further adhesion.

.3 Duct sides and plenum panels greater than the 610mm in width shall also have metal clips or nylon pins adhered to the metal surface at 300mm to supplement the adhesive.

.4 Seal all transverse joints, raw edges, and other points of penetration of the coating with a reinforcing membrane and insulation coasting/sealer.

.5 Seal all longitudinal joints with a insulation coating sealer.

.6 No raw exposed edges shall be exposed to the airstream

3.6 DUCTWORK INSULATION SCHEDULE

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

	Duct Type	TIAC Code	Vapour Barrier	mm
.2	Outside air ducts and exhaust air ducts up to ERV	C-1	yes	100
.3	Combustion air ductwork/piping	C-1	yes	50

.4 Acoustically lined ducts: none

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

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

.3 Finishes: Conform to the following table:

	TIAC Code	Rectangular	Round
.2	Indoor, concealed	none	none
.3	Indoor, exposed within mechanical room	J-1	J-1
.4	Indoor, exposed elsewhere	J-1	J-1

3.7 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

.2 Related Requirements

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.1 ASHRAE Standard 90.1-19, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.3 ASTM International (ASTM)

.1 ASTM B209M-14, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.2 ASTM C449/C449M-07(2019), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.3 ASTM C547-2019, Mineral Fiber Pipe Insulation.

.4 Manufacturer's Trade Associations

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

.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-2018, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-2017, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-14(R2019), Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2-15, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:

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

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section01 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.

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, qualified to standards of TIAC.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

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

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

Part 2 Products

2.1 GENERAL

.1 Provide thermal insulation on all piping, and fittings as as scheduled.

.2 Journeyman insulation applicators, skilled in this trade shall perform the work.

.3 Provide clearance around equipment to allow proper application of insulation.

.4 Coordinate insulation with Div. 26 where piping is heat traced. Provide heat trace channel and coordinate installation of tape.

2.2 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

.3 ULC listed for use in non-combustible buildings.

2.3 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: 0.042W/(m K) 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: 0.042W/(m K) to CAN/ULC-S702.

.5 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: 0.038W/m K.

.4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

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, 19 mm wide, 0.5 mm thick.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.5 mm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Pressure sensitive vinyl tape of matching colour.

.8 Special requirements:

.1 Outdoor: UV rated material at least 0.5 mm thick.

.2 Canvas:

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

.2 Lagging adhesive: compatible with insulation.

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.

.6 Scope of insulation to include the following and as indicated;

.1 Hot water heating supply and return piping

.2 Glycol heating supply and return piping

.3 Flexible branch connections to ceiling radiant panels

.4 Domestic hot and cold water piping

.5 Septic Tank suction piping within 2m of exterior.

.7 Do not insulate the following;

.1 Internal relief piping

.2 Internal drain lines

.8 Insulate the following fittings if the pipe is insulated;

.1 Elbows, tee and reducers.

.9 Apply insulation and jacketing in a clean workmanlike manner so that the finished product is uniform, smooth in finish and pleasing to the eye with longitudinal seams concealed from view.

.10 Terminate insulation short of all control, smoke and fire dampers so as to not interfere with their operation.

.11 Insulation terminations to be cut back at 90° and finish with reinforced scrim cloth and mastic. Insulation with an integral vapor barrier to be finished vapour barrier mastic. Cover onto pipe and over the insulation vapor barrier.

.12 Provide and install 40mm thick insulation flexible glass fibre insulation on top of all hot water ceiling radiant heating panels. Insulation shall be faced on both sides.

.1 Cut insulation to fit dimension of the back each panel and lay insulation on top of each panel.

.2 Insulation shall extend edge to edge.

.3 Insulation shall cover piping directly on top of panel.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints and seal with adhesive as recommended by manufacturer.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

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

.2 TIAC Code: A-1.

.1 Securements: bands at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: bands at 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.

.1 Insulation securements: to manufactures written instructions.

.2 Seals: lap seal adhesive, lagging adhesive.

.5 Insulation Schedule:

.1 Hot Water Heating;

.1 Temperature Range: Up to 59C

.2 TIAC Code: A1

.3 Thickness:

.1 Up to 25mm: 25mm

.2 32mm to 50mm: 38mm

.2 Glycol Heating;

.1 Temperature Range: Up to 59C

.2 TIAC Code: A1

.3 Thickness:

.1 Up to 25mm: 25mm

.2 32mm to 50mm: 38mm

.3 Domestic Hot Water;

.1 Temperature Range: Up to 59C

.2 TIAC Code: A1

.3 Thickness:

.1 Up to 25mm: 25mm

.2 32mm to 50mm: 38mm

.4 Domestic Cold Water;

.1 TIAC Code: A6

.2 Thickness:

.1 Up to 25mm: 25mm

.2 32mm to 50mm: 25mm

.6 Finishes:

.1 Exposed indoors: canvas/ PVC jacket..

.2 Exposed in mechanical rooms: canvas/PVC jacket ..

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

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

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 00 - 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 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 ASTM International (ASTM)

.1 ASTM E202-18, 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 16 - 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 Heat exchanger operation and control

.3 Water heater operation.

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 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.3 When capacity test is completed, return controls and equipment status to normal operating conditions.

1.6 GLYCOL SYSTEMS

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

1.7 FUEL OIL SYSTEMS

.1 Environmental protection systems:

.1 Test oil storage tank leakage detection system using manufacturer's recommended procedures.

.2 Test spill protection and over-fill protection systems using manufacturer's recommended procedures.

.2 Operational Tests:

.1 Charge system and verify operation.

.2 Verify adequacy of flow rates and pressure from storage facilities to burners.

.3 For further details refer to relevant sections of Division 23.

.3 Notify authorities having jurisdiction to enable witnessing of tests as required.

1.8 POTABLE WATER SYSTEMS

.1 When cleaning is completed and system filled:

.1 Verify performance of equipment and systems as specified elsewhere in Division 23.

.2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.

.3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

.4 Confirm operation of hot water tank, tank temperature setpoint and T&P relief.

.5 Adjust temperature limit stops and confirm setting on each faucet.

.6 Confirm operation of hot water recirculation pump.

1.9 SANITARY AND STORM DRAINAGE SYSTEMS

.1 Ensure that traps are fully and permanently primed.

.2 Ensure that fixtures are properly anchored, connected to system.

.3 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

.4 Cleanouts: refer to Section 22 05 15 - Plumbing Specialities and Accessories.

1.10 TRAINING

.1 Perform owner traning and demonstration in accordance with Section 23 05 00 and Div 1 requirements.

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 Requirements

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 ASTM International (ASTM)

.1 ASTM E202-18, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

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

.1 Material Safety Data Sheets (SDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

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

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00- Closeout Submittals .

.2 Operation and Maintenance Data: submit operation and maintenance data for cleaning products, procedures and results for incorporation into manual.

.1 Include flushing and cleaning reports including quantities, times and dates signed off by the contractor to be in accordance with manufacturer requirements.

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

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

.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 Add chemicals under direction of chemical treatment supplier.

.8 Glycol Systems:

.1 In addition to procedures specified above perform specified procedures.

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

3.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

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

.2 Ensure air is removed.

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

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

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment.

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

.8 Repeat with water at design temperature.

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

.10 Bring system up to design temperature and pressure slowly.

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

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

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

.14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during strat-up.

.15 Check operation of drain valves.

.16 Adjust valve stem packings as systems settle down.

.17 Fully open balancing valves (except those that are factory-set).

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

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

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 00 - 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 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

1.3 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 electric and electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit shop drawings in accordance with Section 23 05 00 and with the requirements outlined below.

.4 Shop drawings are to be submitted in an organized fashion complete with table of contents, tab sheets and sequentially numbered pages to enable easy location of information. This also applies to component data sheets.

.5 Submit two (2) copies of the complete shop drawings to the Departmental Representative for review and approval. Partial submissions will not be accepted. Submit three (3) additional copies of the complete approved shop drawings with the O&M Manuals.

.6 Provide sufficient detail to enable the Departmental Representative to evaluate the proposed system and to determine whether the requirements of the specification will be met.

.1 Specification sheets for each item. To include manufacturer's descriptive literature, specification, drawings, diagrams, performance and characteristic curves, catalog cuts, manufacturer's name, trade name, catalog or model number, nameplate data, size, layout, dimensions, capacity, all other data to establish compliance.

.2 General logic diagrams and description.

.3 Controller locations

.4 Panel layouts

.5 Control cabinet locations

.6 Schematic single line diagrams showing cable routing's, conduit sizes, field controllers and systems being controlled, panel layouts

.7 Dampers: schedule listing operator locations, damper sizes, spring return. Engineering/technical data and maintenance information for each system component, including sizing and arrangements as requested. Include calculations for control valve selections

.8 Valves: schedule listing including the following information: designation, service, manufacturer, model, design flow rate, design pressure drop, required Cv, Valve size, actual Cv

.9 Wiring diagrams

.10 Piping diagrams and hook-ups.

.11 Associated field wiring schematics, schedules and terminations

.12 Manufacturer's recommended installation instructions and procedures

1.4 SCOPE

.1 Provide a complete system of automatic controls for the building systems referred to in this specification.

.2 Provide all engineering, materials and services as documented within these specifications and as required to furnish a complete and fully operational control system to monitor and control the building systems referred to in this specification.

.3 The work includes the supply and installation of electronic and electromechanical controllers, instrumentation, control devices, conduit, wiring and other devices as necessary to provide a complete system of automatic controls, compliant with these specifications. The contractor shall be responsible for the detailed engineering, installation, supervision and labour services, calibration, and commissioning necessary for a complete and fully operational system as specified. Adjustment and calibration shall be provided as a prerequisite

.4 Include:

.1 Submittals,

.2 System Documentation,

.3 Acceptance Testing, and

.4 Instructions to Owners as identified within these specifications.

1.5 WORK BY OTHER TRADES

.1 Installation of control valves shall be by the mechanical contractor.

.2 Installation of control dampers shall be by the mechanical contractor.

1.6 DEMONSTRATION AND OWNER'S INSTRUCTIONS

.1 Formal training sessions shall commence only after Operations and Maintenance Manuals drawings have been completed, reviewed and approved by the Departmental Representative and shall supplement to Section 23 05 00, Common Work Results for HVAC, requirements.

.2 Approved Operations and Maintenance Manuals shall be made available during all training in both hard and digital formats

.3 Training to be completed by the Site Technician plus additional individuals who have had specific training as an instructor shall conduct training sessions

.4 All training sessions shall include training materials and shall follow a documented course outline

.5 A copy of the training materials, which shall include a training outline shall be submitted to the Owner for approval three weeks prior to commencing any training sessions

.6 Any training conducted without prior approval of the Departmental Respresentative shall repeated at the discretion of the Departmental Respresentative and/or will not count toward the contractors training obligations.

.7 The Contractor shall provide three weeks written notice to the Departmental Representative and building Owner prior to commencing formal training sessions

.8 Provide for training according to the following schedule

.1 A half day system and component familiarization training;

.1 Operation of hardware components.

.2 Trouble shooting of system and components.

.3 Preventative maintenance.

.4 Alarm management.

.9 All costs for training excluding wages of the building operators shall be covered by the vendor.

.10 Owner representation: The Owners team attending the training will be comprised of a maximum of one operator and one manager.

1.7 WARRANTY

.1 Provide a one year warranty on all items provided under this contract including but not limited to all equipment, wiring and systems. The warranty period shall commence on the date of substantial acceptance.

.2 Provide on-site service including all labor, materials to maintain the complete control system in optimal functioning condition, provided regular maintenance is performed by the Owner.

.3 Regular maintenance of the control system during the warranty period will be completed by the Owner.

.4 Response time: Response within 48 hours and on site within 5 working days or as feasible due to flight and scheduling.

.5 Maintain a service log on site of all control system maintenance activities during the warranty period

1.8 SYSTEM ACTIVATION

.1 Verify that each hardware component has been properly installed as recommended by the manufacturer and is functioning correctly.

.2 Calibrate all devices including sensors, transmitters, transducers, current relays, valve actuators, damper motors, positioners, etceteras, verifying that end to end calibration accuracy as specified has been achieved

.3 Ensure tight shut off and fail safe operation of valves and dampers. Hysteresis shall not be greater than 5% of the operating range

.4 Set damper linkages, static pressure/volume controls as required

1.9 ACCEPTANCE TESTING

.1 A final operational acceptance test shall be conducted on the complete and total installed and operational control system to demonstrate that it is functioning properly in accordance with the specifications. The acceptance test run times shall be a minimum 7 days

.2 The correct operation of all systems shall be demonstrated as well as the operation and capabilities of all sequences, specialized control programs and all hardware Specific testing shall include but not be limited to

- .1 Power Failure Restart
- .2 Ventilation Reset Schedules
- .3 Heating and Cooling Reset Schedules
- .4 Night Setback
- .5 Free Cooling
- .6 Circulation pump OAT controls

.3 In the event of the failure of function, during the test, of any of the hardware components or routines, the test will recommence and run until a minimum of an additional seven failure-free test days added to the original test days have occurred.

.4 After successful completion of the acceptance test, the Departmental Representative will issue written acceptance of the control system

1.10 CLOSEOUT SUBMITTALS

.1 Building Control Operation and Maintenance Manuals to be incorporated into the building mechanical manuals

.2 The Building Control Operation and Maintenance literature shall contain technical data, technician manuals, operational, product data, cleaning and maintenance information on all products and equipment supplied as part of this project

.3 Introduction:

- .1 Provide a written explanation of the layout of the manual.
- .2 List all other control system manuals submitted for this project including all hardware manuals. Identify the quantities of each manual provided.

.4 Control System Design:

- .1 Design Intent:
  - .1 Explain, in this section, the design intent and give a system overview which outlines the relationships between the hardware, operating system, control software and other control components.
  - .2 Provide a detailed description of all parts, components and software in the system.
  - .3 Describe the system architecture. Provide a system configuration schematic with the location, type and model of all control panels, work stations, remote access modems etceteras and identify the major equipment monitored and controlled by each panel.
- .2 Operations:

.1 Provide an overview of the building automation system operations. Include basic instruction on:

.1 system access

.2 alarms management (including, how and where alarms are annunciated, after-hours reporting of critical alarms, etc.)

.3 basic trouble shooting directions.

.2 These instructions are to provide a basic understanding of the system operations and are to reference specific areas of the hardware manuals for further detailed instructions.

.5 Building Systems Descriptions

.1 System Design intent - Explain, in this section, the design intent and give a system overview which outlines the system components and the intended system function.

.2 Provide a schematic, control sequences, wiring diagram, device list.

.3 Control sequences shall identify start-up and shut-down sequences, control loop set-points, reset schedules, system interlocks etceteras.

.4 As built record drawings in 11" X 17" format, folded to fit into the O&M binders may be used to provide part or all of the information required for this section.

.6 Panel Layout

.1 Provide as-built panel layout sheets and include locations of all panels.

.2 Include a panel points list that identifies each point name with concise English description and termination point. Identify panel spare points.

.3 Identify power source for each panel including emergency/normal, UPS, panel number and circuit number.

.7 Shop Drawings

.1 Insert in this section all approved shop drawings as specifed in this section supplmented by requirements of Div. 1.

.8 Equipment Schedules

.1 Provide an equipment schedule for all hardware provided including valves, dampers, actuators, controllers, transducers, input/output devices and other instrumentation.

.9 Certification and Testing

.1 Provide final copies of all completed calibration and verification check sheets including all airflow station calibration check sheets.

.10 Product Manuals

.1 Include in this manual or within product, user manuals and technical manuals, complete and detailed instruction on the use, setup and support of all control system hardware provided under this project.

.11 Maintenance

.1 Provide a description in this section of maintenance procedures for all equipment and systems, as defined in this specification, including a schedule for recommended planned and preventative maintenance work items and intervals.

.2 Provide a list of resources to call upon for maintenance and servicing of equipment which includes name, address and phone numbers for supplier and service contact for each piece of equipment.

.3 Include in this section a complete set of as-built drawings if not included elsewhere in this manual.

.4 Certification, guarantee, warranty.

.12 Additional Manuals

.1 Include all technician manuals.

.2 General manuals required for trouble shooting.

1.11 RECORD DRAWINGS

.1 To requirements of Section 23 05 00 - Common Work Results Mechanical

1.12 SPARE PARTS

.1 To requirements of Section 23 05 00 - Common Work Results Mechanical

.2 Provide the following spare parts:

.1 Two of each type of room thermostats.

.2 Two damper motors.

.3 Two control relays of common relay types.

.4 Special tools to replace components where tools are not commercially available.

.3 Turn all spare parts over to Owner in original manufacturers packaging. Provide completed spare parts list and obtain signature from Departmental Representative representative of receipt of spare parts.

Part 2 Products

2.1 GENERAL

.1 Provide control system components consisting of thermostats, control valves, dampers, actuators, , indicating devices, and interface equipment required to operate mechanical equipment and perform functions specified.

.2 Provide all materials and labour required to connect control components.

.3 No splicing or extending of wiring will be accepted.

.4 Maintain integrity of all fire protection and smoke evacuation systems.

2.2 CONTROL PANELS

.1 Mount controllers in control panels and field interface equipment (i.e. relays, transducers, etc.) in separate field interface control panels.

.2 Control panels are to be of unitized cabinet type construction, fabricated from 2.5 mm rolled sheet metal sheet with baked enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications.

.3 Mount pilot lights, push buttons and switches flush on cabinet panel face.

.4 Mount panels on vibration free walls or free standing angle iron supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.6 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 volt supply.

.7 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.8 Identify all wiring by means of stamped markings on heat shrinkable tubing that is permanently fastened to wiring. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.9 Identify all control panels using lamacoid labelling mechanically affixed to panel.

.10 Provide for input and output sheets to be attached to the inside of the panel doors.

.11 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape.

.12 Where "Hand-Off-Auto" selector switches are specified system to be such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position. "Hand-Off-Auto" selector switches to the motor equipment and variable speed controller schedules.

.13 Control Power for control panel shall be 120 Volts A.C. from panel circuits provided by Division 26. All power to be through the emergency power distribution.

.14 Install bonding conductor between main control and auxiliary panels complete with grounding lugs, in addition to CSA grounding requirements.

.15 All panels in occupied spaces are to be suitable for fully recessed mounting with flush face in occupied space.

2.3 WIRE

.1 Control wiring for digital functions shall be 20 AWG minimum with 300 Volt insulation.

.2 Control wiring for analog functions shall be 20 AWG minimum with 300 Volts insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.3 Sensor wiring shall be 20 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.4 Transformer current wiring shall be 16 AWG minimum.

.5 Identify all wiring and cabling by means of stamped markings on heat shrinkable tubing that is permanently fastened to wiring.

.6 See Div. 26 for requirements of waterproof devices and conduit in washbay.

2.4 CONDUITS AND CABLES

.1 All wiring shall be in steel conduit or trays. Flexible conduit may be used for final connection of control devices. Maximum length of flexible conduit to be 1 m. Conform to Division 26 requirements for conduit and trays specifications.

.2 Seal conduit where such conduit leaves heated areas and enters unheated area.

.3 In the field panel, run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable and wire at every termination point by means of stamped markings on heat shrinkable tubing that is permanently fastened to wiring.

.5 Provide instrumentation complete with standard electrical conduit box for termination unless otherwise noted.

.6 Separate conduits shall be provided for pneumatic tubing and electrical wiring runs.

.7 Color code all conductors and conduits by permanently applied color bands. Color code shall follow base building schedule.

.8 All wiring for terminal equipment controllers including network communications, sensors and actuator wiring must be in conduit or cable tray.

2.5 RELATED ACCESSORIES

.1 Provide and install all necessary transducers, interposing relays, interface devices, contactors, starters and EP's to perform control functions required.

.2 It is the responsibility of the Contractor to identify, within 30 days of award, all additional items not specified that are required to meet the operational intent specified.

.3 Items required but not identified at the time of close of tender shall be the Contractor's responsibility.

2.6 THERMOWELLS

.1 Provide wells for all hydronic sensors

2.7 DAMPER OPERATORS

.1 Provide electronic proportional damper actuators with spring return to “fail-safe” in normally open or normally closed position.

.2 Damper operator’s spring return shall have sufficient torque to provide tight shut off in the most extreme expected operating condition.

.3 Damper actuators shall accept 24VAC or 120V control signal to suit application.

.4 Dampers shall be fully open on command of 100% and closed on a command of 0%. Damper actuators on AHUs to be capable of modulating to a intermediate position to suit O/A position requirements.

.5 Provide end switches on fan shut-off dampers.

.6 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one damper operator per damper section. The damper area driven by each damper operator shall not exceed 1.5 square metres.

.7 Positioning time for full closed to full open not to exceed 90 seconds.

.8 Positioning time for full open to full closed not to exceed 45 seconds.

.9 Where multiple damper actuators are utilized for one damper or multiple damper sections, or where multiple dampers are controlled in unison, all damper actuators shall be controlled by a single output signal.

.10 Where possible do not mount actuators outdoors or in the air stream.

.11 Where actuators must be mounted outdoors, the actuator shall come with an integral heater and shall be mounted in a weatherproof enclosure.

.12 Where actuators must be mounted in the air stream provide actuators with integral heaters.

2.8 PUMP SEQUENCER

.1 Multi Stage Pump Sequencer with the following functions;

- .1 Test Sequence
- .2 Alarm per Pump
- .3 Lead Lag Operation
- .4 Exercising
- .5 Warm Weather Shutdown
- .6 Equal Run Time

.2 Panel to be wall mounted, NEMA 1 rated, 120V, alert relay.

.3 Acceptable Products: Tekmar 132.

2.9 CONTROL VALVES

.1 Provide control valves as indicated on drawings.

.2 Two-way, three way and four-way valves for liquids: Two-way valves shall have equal percentage characteristics and three/four-way valves shall have linear characteristics. Size two-way valve operators to close against maximum pump shut-off head.

- .1 Size control valves as per following criteria:
  - .1 Select two-way control valves for coils, heat exchangers, terminal units, etc., with a nominal pressure drop of 21 kPa.
  - .2 Select three-way control valves for coils, heat exchangers, terminal units etc., for pressure drop equal to three times the equipment pressure drop up to maximum 21 kPa.

.3 Select three/four-way control valves that are in series with a circulation pump for a pressure drop equal to the equipment pressure drop up to maximum 14 kPa.

.2 Where control valves are required for control of unitary devices such as radiator convectors, fin tube convectors, reheat coils, etc., ensure that operator tops are small enough to fit neatly inside corresponding enclosures. Make control valves for unitary devices small enough so that they can be adequately supported by connecting pipe work, otherwise provide angle support brackets between operator and valve body and secure to building structure.

.3 All control valve selections are to be included in shop drawing submission.

2.10 VALVE ACTUATORS

.1 Actuators shall be sized to close the control valve for tight shut-off when operating against maximum system differential pressure and with the installed system pump(s) operating at shut off head.

.2 Valves shall return to normal position on a loss of power as follows:

.1 Preheat, reheat and heating coil valves – normally open to coil unless otherwise noted.

.2 Isolation valves – normally closed/open as indicated in control descriptor logic.

.3 Actuators on valves to have visual mechanical position indication, showing valve position.

.4 Actuators and valves shall be mounted and installed only in the positions approved by the manufacturer. Shop drawings shall clearly indicate acceptable positions.

.5 Combination control isolation and manual isolation valve.

.1 Valves provided by mechanical contractor and will be butterfly or ball type valves. Coordinate with mechanical contractor.

.2 Provide for actuator for automatic operation.

.3 For all combination valves provide manual operator with heavy duty gear hand wheel operator with position indicator.

.6 Electronic Valves

.1 Electronic valves shall have the following minimum performance specifications.

.2 Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation.

.3 Valve actuators must provide proportional valve control in response to a 0 to 10 VDC or 0 to 20ma control signal.

.4 Actuators shall be equipped with an integral position feedback potentiometer to indicate the position of the valve where required by the control sequence.

.5 The actuators must be designed so that they may be used for either clockwise or counter clockwise fail-safe operation.

.6 Run time of actuator shall be constant regardless of torque and travel time from full open to full close shall not exceed 90 seconds.

.7 Spring return control valve operator shall be direct linked to the valve stem through appropriate linkage.

.8 Actuators shall be CSA certified.

.9 Valve actuators installed above ceilings in occupied spaces shall be selected so that noise from valve actuation cannot be detected in the occupied space.

.10 Use of floating type valves for terminal unit heating valve control is acceptable.

2.11 LINE VOLTAGE THERMOSTATIC CONTROLLER

.1 Line voltage, spst, heavy duty.

.2 Provide heavy duty metal guard for public access locations.

2.12 SPACE HEATING THERMOSTATIC CONTROLLER

.1 Electronic microprocessor based floating control with proportional and integral (PI) control action, 24V, to operate modulating dampers or valves and controller.

.2 Single floating output, one on/off output and dry contact type input for global night setback.

.3 Sensor: internal.

2.13 FLOAT SWITCHES

.1 Type 1: Paddle type, spdt, snap acting, line voltage, water flow switch, CSA approved

.2 Type 2:Non mercury, float, SPDT, line volt.

2.14 SELECTOR SWITCHES

.1 CSA Approved

.2 Size:

.1 Mechanical Room: 30.5mm

.2 Occupied Spaces: provide suitable finished swithces of minimum size

2.15 CAPILLARY OPERATED CONTROL VALVES

.1 Body: Bronze contruction, three-way diverting operation, approved to 120C, 860kpa operating pressure

.2 Stem: Stainless Steel

.3 Actuator: Capillary operated actuator, remote liquid filled bulb, 10C-49C operating range, 8ft capillary.

.4 Standard of Accetance: Honeywell V135/T100, IMCA, Danfoss

2.16 PILOT LAMPS

.1 LED; push test.

2.17 IDENTIFICATION

.1 Provide all cabinets, and main equipment with nameplate or nameplate tag to requirements of Section 23 05 53 and as follows:

- .1 Permanently attached to the component.
- .2 Black and white lamacoid plastic with 8 mm bold lettering.
- .3 Include the following:
  - .1 Panel descriptor, ID, clear text descriptor.

.2 Provide and install plastic credit card type nameplates, including descriptor, ID and clear text descriptor, for all discrete items of equipment supplied including but not limited to:

- .1 Sensors
- .2 transmitters
- .3 output devices
- .4 controllers
- .5 valves
- .6 terminal air boxes

.3 Provide self-adhesive lamicoid labels, attached to operating equipment under control as directed by the Departmental Representative. Labels have white letters on red background stating:

- .1 WARNING
  This equipment operates under remote control and may start at any time. Phone for instructions before operating.

.4 Submit sample for approval.

Part 3 Execution

3.1 INSTALLATION

.1 Install all components in accordance with the latest regulations of the Canadian Electrical Code, applicable Municipal and Territorial Codes and Regulations, and latest CSA Electrical Bulletins.

.2 Verify location of thermostats and other exposed control sensors with drawings before installation. Locate thermostats 1200 mm above floor.

.3 Outdoor air sensors: installation location shall be verified to not be affected by sun load. For multiple units provide programing to select units not affected by the sum load based on time of day.

.4 Install damper motors on outside of ducts. Do not locate in outside air stream.

.5 Fans that are to be sequenced with intake or discharge dampers through a single output point, shall be wired such that operation of damper end switch alone will not start fan. I.E. The end switch and power on command must both be required to start the fan when the "hand/off/auto" selector switch is in the auto position

.6 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building. Locate where they will not be affected by sun load. Provide suitable shielding. Coordinate installation location with Departmental Representative

.7 Install all safety limits at the operators level

.8 Install pressure gauges on branch lines and actuator excepting individual room thermostats

.9 Control System Power

.1 Provide power to all control system components as necessary to provide continued monitoring and control.

.2 Control systems may be powered from a common circuit provided that:

.1 Circuit loading does not exceed 900 VA

.2 A minimum of one circuit per air system is provided for the terminal equipment controllers associated with the air system, and

.3 Terminal equipment controllers for different air systems are not powered from the same circuit

.3 Power for all transducers and other instrumentation associated with a controller shall come from the same circuit that is feeding the digital controller

.4 Identify in the record drawings and in the control panel the panel and circuit number serving each controller.

3.2 SEQUENCE OF OPERATIONG - CONTROL LOGIC DESCRIPTION

.1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden

.2 Consult with the Departmental Representative during the shop drawing stage to finalize the control sequences for each system

.3 Sequences shall be as follows;

.1 Air Systems;

.1 The primary air system provides dedicated outdoor air (DOAS) to the each individual dwelling unit. The ERV is a two fan regenerative exchanger energy recovery ventilator. The system is to operate continuously on low speed to provide minimum ventilation as indicated. On activation of boost controller in bathroom and kitchen or on detection of high humidiy level, unit to revert to high speed and two-position air flow valve to modulate to high volume poitsion as described below..

.1 Air flow valve provides on-off control for ventilation systems requiring a low volume continuous exhaust and ondemand boost via a normally closed spring-return actuator. Whenddenergized, the power will remain off and the minimum flow Constant Airflow Regulator shall regulate airflow to a specified low volume continuous flow rate across a pressure range of 0.12 and 1.2 in. w.g. (30 to 300 Pa). When energized, the minimum flow damper shall energize and rotate out of the

airstream allowing the maximum flow Constant Airflow Regulator to automatically balance the exhaust rate to the specified maximum airflow rate

.2 The ERV is with factory PLC control for frost damper operation, unit status and fan speed control. The PLC is to be factory programmed so that on frost damper failure the unit shuts down and alarms. Connect alarm to local panel..

.3 Locate boost controllers as shown on plan in kitchen, washroom. Main system controller to be located in Living area. When energized at controller, OA and EA dampers shall open and fan shall start. Internal dampers to operate

.4 Range hood shall operated based on internal controls.

.2 Heating System;

.1 Heating and domestic service water are provided by a central combination hot water system. Combined heaters are piped and operate in parrallel for redundant operation.

.2 Tanks to be set to operate at 60degC. Tank temperature to be maintained by integral burner control.

.3 Primary heating pumps, P-3 and P-4 shall operate on a call for heat from any of the heating zone controller. Pumps to operate in duty/stand-by configuration and shall be controlled by a pump sequencer

.1 Lead pump shall switch weekly to equalize run-time

.2 Pumps to be excercised for 5min weekly while denergized.

.3 On failure of lead pump, stand-by pump shall energize and alarm shall generate at panel.

.4 On a call for heat from the local thermostat, zone circulator shall energize.

.5 When outdoor air temperature drops below -10C, coil pump, P-5, to energise. ERV reheat coil control valve shall modulate to maintain discharge air temperature at 20C.

.3 Plumbing System:

.1 Description: Potable water and sanitary holding are on trucked services with water fill and sanitary removal provided by the local municipality. DW is provided by a single DW holding tank in the crawlspace and a simplex pressure pump system. Sanitary holding is by a single sanitary holding tank in the crawlspace. DHWH heating is by a two parrallel oil fired DHWHs

.2 DW pressure pump to operate from inline pressure swtich. Set pump to operate at 40/60 psi operating range.

.3 On low DW tank level or high sewage tank level the DW pumps to be locked out with auto reset after the fault condition is corrected and after a 5min (adjustable) short cycle delay

.4 On low DW tank level the exterior low DW lamp to be activated. On high sanitary tank level the high Sanitary Tank lamp to be activated. Lamps to be located on building exterior as indicated. Indicate low DW and high sanitary tanks

.5 On full DW tank level the exterior Full DW tank lamp to be activated. Auto off after 15min delay. Secondary indicator light to remain on at fill location until float high level condition is cleared.

.6 Exterior lamps to be LED. Coordinate with Div 26 for provision and installation.

.7 DHWH operation by integral controller including high limit. Lock out DHWH when DW tank level low

.8 Domestic hot water recirc pump P-2 to operate continuously while energized by local on/off diconenction. Pump speed shall modulate based on internal control and sensors to maintain system water temperature.

.9 DWV vents through the roof are with self regulating electric heat traced VTR with thermostatic controllers. Set controllers to maintain VTF temperatures at 40degF

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 American Society of Mechanical Engineers (ASME)

- .1 ASME-B16.3-2016, Malleable-Iron Threaded Fittings: Classes 150 and 300.
- .2 ASME-B16.9-2018, Factory-Made Wrought Steel Buttwelding Fittings.

.3 ASTM International (ASTM)

- .1 ASTM A47/A47M-99 (2018)e1, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-20, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 ASTM B61-15, Standard Specification for Steam or Valve Bronze Castings.
- .4 ASTM B75M-2020, Standard Specification for Seamless Copper Tube Metric.

.4 Canadian Environmental Protection Act (CEPA)

- .1 CCME PN 1326-2015, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.

.5 CSA Group (CSA)

- .1 CSA-B139-19, Installation Code for Oil Burning Equipment.
- .2 CSA-B140.0-03, Oil Burning Equipment: General Requirements.

.6 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)

- .1 MSS-SP-80-19, Bronze Gate, Globe, Angle and Check Valves.

.7 National Research Council Canada (NRC)

- .1 National Fire Code of Canada 2015 (NFC).

.8 Underwriter's Laboratories of Canada (ULC)

- .1 CAN/ULC S603.1-2017, External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids.
- .2 ULC ORD-C107.12-2018, Line Leak Detection Devices for Flammable Liquid Piping.

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, specifications and datasheets for piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Indicate on manufacturer's catalogue literature the following: valves, tanks, fitting and all appurtenances.

.3 Provide submittals for field fabricated support for fuel oil tank to requirements of Section 23 05 18 - Vibration and Seismic Control for HVAC.

.4 Test Reports:

.1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Certificates:

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

.6 Manufacturers' Instructions: provide manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 PIPING MATERIAL

.1 Materials as per CSA-B139, CEPA SOR/2008-197, NFC.

.2 Fill, Vent and Carrier Pipe: Steel: to ASTM A53/A53M, Schedule 40, continuous weld or electric resistance welded, screwed.

.3 Suction Line: Copper: type K, soft copper tubing, to ASTM B75M, in long lengths.

2.2 JOINTING MATERIAL

.1 Screwed fittings: red paste jointing compound, teflon not acceptable..

2.3 FITTINGS

.1 Steel:

.1 Malleable iron: screwed, banded, Class 150 to ASME-B16.3.

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

.3 Nipples: Schedule 40, to ASTM A53/A53M.

.2 Copper:

.1 Flared FIttings to CSA-B139

.2 Connections to equipment: compression.

.3 Flexible:

.1 Braided 300 series stainless steel, sized as per the drawings, ULC approved.

2.4 GATE VALVES

.1 NPS 2 and under, screwed bonnet: rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, solid wedge disc as specified under Section 23 05 23.01 - Valves - Bronze.

2.5 BALL VALVES

.1 NPS 2 and under: bronze body, screwed ends, TFE seal, hard chrome ball, 4 MPa, WOG as specified under Section 23 05 23.01 - Valves - Bronze.

2.6 SWING CHECK VALVES

.1 NPS 2 and under, screwed: to MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc,, screw in cap, regrindable seat as specified under Section 23 05 23.01 - Valves - Bronze.

2.7 MAIN SYSTEM OIL FILTER

.1 Cartridge type, stainless steel construction, 25mm (1") inlet and outlet, 10 gpm max, provide two spare filters and mounting bracket.

.2 Include Filter Tray.

2.8 FUSIBLE VALVES

.1 ULC listed, 74C fusible link, all purpose capable of manual closure, sized as per the line size on the drawings.

.2 Standard of Acceptance: Morrison Bros 939 Fusible Globe Valve.

2.9 PRESSURE GAUGE

.1 steel case, bottom 1/4" NPT connection, brass movement, 0-30 psi.

.2 Standard of Acceptance: Winters E199.

2.10 ABOVEGROUND EXTERIOR TANK

.1 Steel construction, horizontal double wall integral containment tank, to CAN/CSA-S601, single integral step,
vent with whistle alarm and weather cap, level gauge, secondary containment vent and inspection port and bung for leak alarm, connections as indicated on the drawings.

.2 At minimum provide;

.1 Spill box with lockable lid and fill cap

.2 Three (3) 5mm (2") NPT bungs

.3 75mm (3") Emergency Vent

.4 Gournding and lifting lugs,

.5 Field fabricated support stand to 23 05 48. Stand to designed and approved prior to installation, provide submittals to requirements of Section 01 33 00

.3 Capacity: 570L

.4 Standard of Acceptance: Grandby, Wico, Tidy

2.11 REMOTE VISUAL TANK GAUGE

.1 LCD display, up to 4 tanks, volume read-out, audible alarm function, NEMA 4X enclosure, +/- 0.3" accuracy, 4 programmable setpoints per tank, ULC listed.

.2 Standard of Acceptance: Morrison Bros 1218 Electronic Tank Gauge.

2.12 FUEL DEAERATOR

.1 Combination fuel de-aerator and fuel filter, max nozzle capacity 110 L/h, complete with mounting bracket.

.2 Standard of Acceptance: SPX Tigerloop Combi-3

.3 Include Filter Tray.

2.13 OIL FILTER

.1 Duplex type replaceable cartridge type as recommended by oil burner manufacturer.

.2 Furnish spare filter cartridge.

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 PIPING

.1 Install piping in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified.

.2 Install oil piping system in accordance with CSA-B139.

.3 Slope piping down in direction of storage tank unless otherwise indicated. All piping to be installed above tank level.

.4 Above ground piping to be protected from physical impact due to impact.

.5 Piping inside building:

- .1 Use flare joint to CSA-B139 for copper piping.
- .2 Provide all necessary isolation, check valves, unions and strainers to complete the installation.

.6 Fill, vent, suction and return piping outside building:

- .1 Steel piping welded throughout except at tanks where electrically isolating fittings are used.
- .2 Grading: slope piping at 1 % minimum back to tanks.

.7 Piping at tanks:

- .1 Suction: terminate 150 mm from bottom of tank …….
- .2 Comply with CSA-B139 for piping for venting at tanks including venting whistle.

.3 Fill pipes: install to comply with CSA-B139.

.1 Include liquid tight tamperproof cover.

.2 Provide spill containment with lockable lid on fill.

.4 Dipstick: extend tube to within 150 mm from bottom of tank. Terminate at grade with lockable cap and chain, and watertight cover.

.8 Clearly label piping runs in legible form indicating;

.1 Piping product content.

.2 Direction of flow.

.9 Testing: Pressure test all piping to 35 kPa [15 psi] or 1.5 times working pressure. Ensure no loss of pressure over a period of 4 hours. Soap test all joints for tightness. Test to be witnessed by Conultant or Third Party
Representative.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless approved otherwise by Departmental Representative.

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

3.4 FUEL OIL TANKS

.1 Install tanks in accordance with CAN/CSA-B139 and manufacturer's directions

.2 Provide seismic bracing. See Section 23 05 48.

.3 Position exterior tanks using lifting lugs and hooks, and where necessary use spreader bars. Do not use chains in contact with tank walls

.4 Exterior tanks and elevated non-combustible stand to be installed secured to structural foundation with approved anchors. See structural drawings for foundation details. Tank supports to be designed by contractor retained Engineer. Provide stamped engineered submittals in accordance with Section 23 05 29

3.5 OIL FILTERS

.1 Provide drip tray under all filters. Min size 300x300mm

.2 At time of acceptance, replace filter cartridge with new.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Test system to CSA-B139 and CSA-B140.0 and authorities having jurisdiction.

.2 Isolate tanks from piping pressure tests.

.3 Verify all vents and opening are free of obstructions and protected.

.2 Manufacturer's Field Services:

.1 Have manufacturer of products, suppling materials for Work of this Section, review Work involved in handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

3.7 CLEANING

.1 Clean in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems, supplemented as follows:

.1 Dispose of fuel oil used for flushing out in accordance with requirements of authority having jurisdiction.

.2 Ensure entire installation is approved by authority having jurisdiction.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 American National Standards Institute (ANSI)/American Welding Society (AWS)

.1 ANSI/AWS A5.8/A5.8M-19, AMD1 Specification Filler Metals for Brazing and Braze Welding.

.3 ASME

.1 ANSI/ASME B16.4-16, Gray-Iron Threaded Fittings Classes 125 and 250.

.2 ANSI/ASME B16.15-18, Cast Copper Alloy Threaded Fittings Classes 125 and 250.

.3 ANSI B16.18-18, Cast Copper Alloy, Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.22-18, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.4 ASTM International (ASTM)

.1 ASTM B32-20, Standard Specification for Solder Metal.

.2 ASTM B61-15, Standard Specification for Steam or Valve Bronze Castings.

.3 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 ASTM B88M-2020, Standard Specification for Seamless Copper Water Tube Metric.

.5 ASTM E202-18, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.5 Manufacturers Standardization Society (MSS)

.1 MSS SP67-2017, Butterfly Valves.

.2 MSS SP80-2019, Bronze Gate, Globe, Angle and Check Valves.

1.3 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 hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on manufacturers catalogue literature the following: valves.

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 hydronic systems 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 TUBING

.1 Type K or L hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.

2.3 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32.

.2 Silver solder BCUP: to ANSI/AWS A5.8.

.3 Brazing: as indicated.

2.4 VALVES

.1 Connections:

.1 NPS 2 and smaller: ends for soldering.

.2 Balancing, for TAB:

.1 Sizes: calibrated balancing valves, as specified.

.2 NPS 2 and under:

.1 Mechanical rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.3 Drain valves: gate, Class 125.

.4 Swing check valves:

.1 NPS 2 and under:

.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.5 Silent check valves:

.1 NPS 2 and under:

.1 As specified Section 23 05 23.01 - Valves - Bronze.

.6 Ball valves:

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

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 15- Common Installation Requirements for HVAC Pipework

.2 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.3 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.4 Slope piping in direction of drainage and for positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

.7 Protect openings in piping and equipment by capping or plugging to prevent entry of dirt or debris during construction.

.8 Maintain a minimum of 25mm space between adjacent flanges or pipe insulation

.9 Run all piping inside thermal envelope

.10 Install dielectric type unions or flanges where copper piping connects to steel in “OPEN” systems

.11 Avoid running piping over electrical equipment. Where unavoidable and approved by Electrical Consultant, provide galvanized drip pans under piping and pipe to drain.

.12 Repair any leaks with new piping and fittings. Do not caulk or cement leaking piping

.13 Install all piping systems with due regard and provision for expansion avoiding strain or damage to equipment and building. Pay particular attention to piping running horizontal across building expansion joints and provide adequate expansion and contraction for all such piping

3.3 VALVE INSTALLATION

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

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

.3 Install ball valves for glycol service.

.4 Install balancing valves in the return piping connection to each terminal heating unit.

.5 Provide valves upstream of all meters, gauges, air vents and equipment

.6 Use swing or spring loaded check valves in horizontal and vertical upflow pipes and on the discharge of pumps, unless check valve is integral to pump. Located spring loaded check valves 8 pipe diameters from pump discharge or elbows

3.4 CONNECTION TO EQUIPMENT

.1 Install unions or flanges at connections to all equipment and specialty components

.2 Connect to equipment in accordance with manufacturers written instructions

.3 Align and independently support piping connections adjacent to equipment to prevent piping stress being transferred.

3.5 DRAIN VALVES

.1 Pipe the discharge of all liquid relief valves, liquid safety valves, high capacity air vents, drip pans, blow downs, overflows and system drains to nearest building drain where discharge is not considered hazardous.

.2 Install drain valves and hose bibb connections at each low point in the piping system and as indicated

.3 Install NPS ¾ hose bibbs at all downfed terminal heating units

.4 Install caps with chains or hose end adapters.

3.6 CIRCUIT BALANCING VALVES

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

.2 Lock handwheel after installation and TAB is complete.

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

3.7 FLUSHING AND CLEANING

.1 In accordance with Section 23 08 16- Cleaning and Start-Up of Mechanical Piping Systems .

3.8 BALANCING

.1 In accordance with Section 23 05 93- Testing, Adjusting and Balancing for HVAC for applicable procedures

3.9 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.

.2 Test system in accordance with Section 23 05 00- Common Work Results for HVAC

3.10 GLYCOL CHARGING

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

.2 Retest for concentration to ASTM E202 after cleaning.

3.11 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.1 ANSI/AWWA C111/A21.11-17, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.3 American Society of Mechanical Engineers (ASME)

.1 ASME B16.1-20, Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

.2 ASME B16.3-16, Malleable Iron Threaded Fittings: Classes 150 and 300.

.3 ASME B16.5-20, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.

.4 ASME B16.9-18, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1-12, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).

.6 ASME B18.2.2-15, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.4 ASTM International (ASTM)

.1 ASTM A47/A47M-2018, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-20, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536-2019, Standard Specification for Ductile Iron Castings.

.4 ASTM B61-18, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM E202-18, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.5 CSA Group (CSA)

1.3 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 hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Components and accessories.

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 hydronic systems for incorporation into manual.

.1 Include special servicing requirements.

1.5 DELIVERY, STORAGE AND HANDLING

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

.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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PIPE

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

.1 To NPS 6: Schedule 40.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with PTFE tape.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.3 Pipe thread: taper.

.4 Bolts and nuts: to ASME B18.2.2 and ASME B18.2.1.

2.3 FITTINGS

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

.2 Butt-welding fittings: steel, to ASME B16.9.

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

.4 Fittings for roll grooved piping: ductile iron to ASTM A536.

2.4 VALVES

.1 General:

.1 Except for specialty valves, to be single manufacturer.

.2 Products to have CRN registration numbers.

.2 Connections:

.1 NPS 2 and smaller: screwed ends.

.3 Balancing, for TAB:

.1 Sizes: calibrated balancing valves, as specified this section.

.2 NPS 2 and under:

.1 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.3 Calibrated balancing valve with memory, positive shut-off, inlet and outlet pressure measuring connection and drains.

.4 All valves in contact with domestic water shall be lead-free and NSF approved.

.5 Calibration chats and adjustment tools to be included.

.4 Swing check valves: to MSS-SP-71.

.1 NPS 2 and under:

.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.5 Silent check valves:

.1 NPS 2 and under:

.1 As specified Section 23 05 23.01 - Valves - Bronze.

.6 Ball valves:

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

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class 600 [4140-kPa CWP] [2760-kPa CWP] , 860 kPa steam.

.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: full port, replaceable hard chrome solid ball and Teflon seats.

.7 Stem seal: PTFE with external packing nut.

.8 Operator: removable lever handle.

.7 Drain Valves:

.1 Globe type, bronze body with bronze trim and composition disc.

.8 Hose Bibb:

.1 Brass ball valve with forged brass cap and chain, NPS ¾ male threaded hose end.

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

.2 Weld all piping NPS 2 and over. Remove welding slag or other foreign material from piping. Ream piping end and clean dirt and scale from inside and outside prior to assembly.

.3 Protect openings in piping and equipment by capping or plugging to prevent entry of dirt or debris during construction.

.4 Maintain a minimum of 25mm space between adjacent flanges or pipe insulation

.5 Install thermometer wells and immersion sensor wells as indicated. Where wells will restrict flow, increase pipe size to at least NPS 2.

.6 Install piping to conserve headroom and coordinate with other trades. Run all piping inside thermal envelope.

.7 Use long radius elbows.

.8 Arrange piping to allow piping to be drained and vented. Use eccentric reducing fittings flush to top side.

.9 Install dielectric type unions or flanges where copper piping connects to steel in “OPEN” systems.

.10 Avoid running piping over electrical equipment. Where unavoidable, provide galvanized drip pans under piping and pipe to drain.

.11 Repair any leaks with new piping and fittings. Do not caulk or cement leaking piping.

.12 Install all piping systems with due regard and provision for expansion avoiding strain or damage to equipment and building. Pay particular attention to piping running horizontal across building expansion joints and provide adequate expansion and contraction for all such piping.

.13 Install expansion loops where required or as indicated to prevent undue stress on piping, building or equipment. Expansion loops shall be of all welded construction with long radius elbows.

.14 Install at least three elbows in all branch connections. Where space does not permit three elbows, install braided flexible pipe connections. Branch connection shall have sufficient developed length to ensure excessive stress are not generated in the piping and shall in no case be less than 900mm

3.2 VALVES

.1 Install with stems upright or at 45deg from horizontal unless approved otherwise.

.2 Install control valves with their stems upright.

.3 Use gate valves, or ball valves for NPS 2 and smaller, to shut of branch piping and equipment.

.4 Use globe valves to control flow in circuits unless balancing valves are specifically indicated.

.5 Use plug cock for balance valves in water return branch mains and branch connections to return mains. Balancing valves are to be provided with independent isolation.

.6 Install balancing valves in the return piping connection to each terminal heating unit.

.7 Provide isolation valves in all systems such that each section of piping and equipment can be isolated.

.8 Provide valves upstream of all meters, gauges, air vents and equipment.

.9 Use swing or spring loaded check valves in horizontal and vertical upflow pipes and on the discharge of pumps, unless check valve is integral to pump. Located spring loaded check valves 8 pipe diameters from pump discharge or elbows.

3.3 CONNECTION TO EQUIPMENT

.1 Install unions or flanges at connections to all equipment and specialty components.

.2 Install removable spool piece, min. 300mm, on the suction and discharge of end suction pumps or as required for ease of maintenance.

.3 Connect to equipment in accordance with manufacturers written instructions.

.4 Align and independently support piping connections adjacent to equipment to prevent piping stress being transferred.

3.4 DRAIN VALVES

.1 Pipe the discharge of all liquid relief valves, liquid safety valves, high capacity air vents, drip pans, blow downs, overflows and system drains to nearest building drain where discharge is not considered hazardous.

.2 Install drain valves and hose bibb connections at each low point in the piping system and as indicated.

.3 Install NPS ¾ hose bibbs at all downfed terminal heating units.

.4 Install caps with chains or hose end adapters.

3.5 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated. Maintain minimum clearances upstream and downstream as dictated by manufacturer.

.2 Lock handle after installation and when TAB is complete. Note setting in TAB report

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

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

3.6 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 16 - Cleaning and Start-Up of Mechanical Piping Systems.

3.7 TESTING

.1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.

3.8 BALANCING

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

.2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.9 GLYCOL CHARGING

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

.2 Retest for concentration to ASTM E202 after cleaning.

3.10 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 13 - Performance Verification Mechanical Piping Systems.

3.11 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

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

3.12 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2021.

.3 ASTM International (ASTM)

.1 ASTM A47/A47M-2018, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-2020, Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-17, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-2019, Standard Specification for Ductile Iron Castings.

.5 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 CSA Group (CSA)

.1 CSA B51-19, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 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 expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

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 hydronic specialties for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

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

.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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic specialties from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

.1 Vertical pressurized diaphragm type expansion tank.

.2 Size & Capacity:

.1 Heating System Expansion Tank;

.2 Tank Volume: 8L,

.3 Min acceptance volume: 3.8L

.4 Dimensions: 200 dia x330mm h

.5 Connection:1/2 NPT

.3 For expansion tanks with a working pressure up to 207kPa and less than 610mm in diameter;

.1 Steel Construction

.2 Factory tested to 510kPa

.3 Identification showing;

.1 Manufacturers name,

.2 Operating pressure,

.3 Capacity,

.4 Test pressure

.5 Date of manufacturer

.4 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.

.5 Working pressure: 520 kPa.

.6 Air precharged to 84 kPa (initial fill pressure of system).

.7 Base mount for vertical installation.

.8 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

.9 Pipe connections;

.1 Sizing as per drawings

.2 System Connection

.3 Drain at bottom

.4 Vent at top

.5 Inspection Tappings

2.2 GLYCOL FILL SYSTEM

.1 General : feeder compatible with glycol solutions of up to 60% concentration, unit to be completely assembled.

.2 System shall include 25 litre storage/mixing tank with cover; pump suction hose with inlet strainer; pressure pump with thermal cut-out; integral pressure switch; integral check valve; cord and plug; pre-charged accumulator tank with EPDM diaphragm; manual diverter valve for purging air and agitating contents of storage tank; pressure regulating valve adjustable (35 – 380 KPa) complete with pressure gauge; built-in check valve; union connection; 12 mm x 900 mm long flexible connection hose with check valve; low level pump cut-out. Pressure pump shall be capable of running dry without damage.

.3 Power supply 115/60/1 0.7 A.

.4 Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.

2.3 PROPELYENE GLYCOL

.1 Factory premixed with demineralized distilled, deionized or reverse osmosis filtered water. Acceptable water quality to have trace quantities of chloride and sulfate within manufacturers specifications and total hardness of <100ppm CaCO3.

.2 Inhibited, low toxicity, high temperature propylene glycol with advanced inhibitor package for copper components, suitable for film temperatures to 160°C and freeze protection to -13°C (30% vol)

.3 Virgin glycol only.

2.4 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 860 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115 degrees C working temperature.

.4 Acceptable products; Honeywell EA122A1002, Taco, Armstrong

2.5 AIR SEPARATOR - IN-LINE

.1 Vortex type vertical air separator with side tangential inlet and outlet connections, top air connection and bottom drain.

.2 Working pressure: 860 kPa.

.3 Size: as indicated.

.4 Acceptable Products: Amtrol, Spirax Sarco, Califactio

2.6 COMBINATION SEPARATORS/STRAINERS

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

2.7 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.8 PIPE LINE STRAINER

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

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

.3 NPS 2 to 12: T type with ductile iron body to ASTM A536, grooved ends.

.4 Blowdown connection: NPS 1.

.5 Screen: stainless steel with 1.19 mm perforations.

.6 Working pressure: 860 kPa.

.7 Acceptable Product: Toyo Fig. 380, Crane, Spirax/Sarco

2.9 PRESSURE RELIEF VALVE

.1 Body: Bronze or cast iron, screwed

.2 ASME rated, operating pressure of 860 kPa and 99C.

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 hydronic specialties installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 APPLICATION

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

3.3 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 Departmental Representative's directive.

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

3.4 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

3.5 AIR VENTS

.1 Install air vents at high point in piping systems and where shown on drawings. Install on tee and not on horizontal pipe runs or elbow.

3.6 EXPANSION TANKS

.1 Adjust expansion tank pressure as indicated.

.2 Install lockshield type valve at inlet to tank.

.3 Secure expansion tank as directed by Seismic Engineer.

3.7 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

.2 Install as indicated and on each system. Install between heating equipment and isolation valve.

.3 Sizing to suit heat input of the equipment.

3.8 SUCTION DIFFUSERS

.1 Install on inlet to pumps having suction size greater than 75.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.1 ANSI/ASHRAE/IES Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.3 CSA Group (CSA)

.1 CAN/CSA-B214-21, Installation Code for Hydronic Heating Systems.

.4 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.5 National Electrical Manufacturers' Association (NEMA)

.1 NEMA MG 1-2019, Motors and Generators.

1.3 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 pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 Shop Drawings:

.1 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.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps 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 hydronic pumps from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 EQUIPMENT

.1 Construction shall permit complete servicing without breaking piping or motor connections.

.2 Pumps shall operate at 1750 RPM unless specified.

.3 Motors powered by VFD controller shall be EEMAC Class B with Type F insulation and shall have a 1.15 service factor. Provide written confirmation from manufacturer that motors are designed around the use of VFD and can withstand the associated power conditions.

2.2 WET ROTOR VARIABLE SPEED HORIZONTAL IN-LINE PUMP

.1 Casing: Cast iron with gauge taps. Stainless steel for domestic water applications.

.1 Flanged or screwed inlet and outlet connections

.2 Impeller:

.1 Composite PES 30% GF

.3 Shaft:

.1 Ceramic

.4 Ratings: 110 degrees C, 1000 kPa

.5 Motor:

.1 Permanent magnet (PM) motor, integral VFD, cooled by pumped fluid, self ventilating.

.6 Bolt-on integrated, CSA or ETL certified variable speed frequency drive assembly with automatic control function to adjust the proportional pressure and set an efficient performance curve. Operating panel with control modules and indications for pump flow rate and head.

.7 Bearings: ceramic

.8 Gasket material: EPDM

.9 Approvals: cULus listed

.10 Acceptable Material: Grundofs, Taco, B&G

.11 Power: 120V/1ph/60Hz

.12 Capacity:

.1 P-5:

.1 Service: ERU Reheat

.2 Capacity: 0.02 L/s @ 2.3m

.3 Power: 120V/1ph/60

.2 P-6

.1 Service: Second Floor Heating

.2 Capacity: 0.075 L/s @ 2.1m

.3 Power: 120V/1ph/60

.3 P-7:

.1 Service: Main Floor Heating

.2 Capacity: 0.075 L/s @ 2.1m

.3 Power: 120V/1ph/60

.4 P-8:

.1 Service: Main Floor Entrance Heating

.2 Capacity: 0.03 L/s @ 1.25m

.3 Power: 120V/1ph/60

.5 P-9:

.1 Service: Crawlspace Heating

.2 Capacity: 0.02 L/s @ 1.3m

.3 Power: 120V/1ph/60

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 data sheets.

3.2 INSTALLATION

.1 Install hydronic pumps to: CAN/CSA-B214.

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

.1 Support at inlet and outlet flanges or unions.

.2 Install with bearing lubrication points accessible.

.3 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.

.4 Pipe drain tapping to floor drain.

.5 Check rotation prior to start-up.

.6 Install pressure gauge test cocks.

3.3 START-UP

.1 General:

.1 In accordance with manufacturer's recommendations.

.2 Procedures:

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

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

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

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

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

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

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

.8 Eliminate cavitation, flashing and air entrainment.

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

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

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2021.

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

.1 Material Safety Data Sheets (SDS).

1.3 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 HVAC water treatment systems and include product characteristics, performance criteria, physical size, finish and limitations.

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 HVAC water treatment systems for incorporation into manual.

.3 Include following:

.1 Log sheets as recommended by manufacturer. Include times, dates, sign off and comments.

.2 Submit written report containing test results and list of chemicals added

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 HVAC water treatment systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

.1 All chemicals specified in this section are to be non-toxic when release to atmosphere, noncorrosive and non-staining is a leak occurs.

.2 All chemical to be approved by owner and authority for release into sewer system

.3 For each treatment system for which chemicals are supplied, supply and hand over to the Owner at substantial, spare chemical in original container. Quantity to be sufficient for two months of treatment of system.

2.2 CHEMICALS

.1 System Cleaner:

.1 Liquid form alkaline type cleaner consisting of a concentrated blend of highly active penetrating agents and detergents with a 14pH and specifically formulated to remove oil, mill scale and oxides from piping and equipment.

.2 Closed Heat System Treatment:

.1 Chemicals, chemical feed equipment and test equipment to be control corrosion in closed heat transfer circulating systems as indicated on the drawings and as specified.

.2 Treatment to be chromate free, nitrite/borate type corrosion inhibitor suitable for use with both ferrous and non-ferrous metals.

.3 Provide inhibitor test kit.

.3 Boil-out

.1 Boil-Out chemicals to be selected by treatment manufacturer and boiler supplier.

.2 Provide alkalinity, Sulphide and PH test kit

2.3 TEST EQUIPMENT

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler and Pressure Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.3 CHEMICAL FEED PIPING

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

3.4 CLEANING OF MECHANICAL SYSTEM

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative.

.2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.

.3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.

.4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions approved by authority having jurisdiction.

3.5 FIELD QUALITY CONTROL

.1 Start-up:

.1 Start up water treatment systems in accordance with manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.3 ASTM International (ASTM)

.1 ASTM A480/A480M-20a, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M-15b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.

.3 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.4 National Fire Protection Association (NFPA)

.1 NFPA 90A-21, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-21, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

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

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

1.3 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.

1.4 DELIVERY, STORAGE AND HANDLING

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

.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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

.1 Maximum Pressure Pa----SMACNA Seal Class
500 ----------B
250 ----------B
125 ----------C

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

.3 Class C: transverse joints and connections made air tight with sealant. Longitudinal seams unsealed.

2.2 SEALANT

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

.1 Acceptable Manufacturers: John Manville, Manson Insulation, Knauf Insualtion.

2.3 DUCT LEAKAGE

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

2.4 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: short radius with single thickness turning vanes standard radius.

.2 Round: smooth radius, centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with 45 degrees entry on branch.

.2 Round main and branch: enter main duct at 45 degrees with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 as indicated.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.5 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Galvanized steel lock forming quality, having galvanized coating of 380 g/m^2 to ASTM A653M-G90 designation for both sides.

.3 Thickness, fabrication and reinforcement: to SMACNA.

.1 Rectangular: Lock formed to SMACNA . Thickness as Follows;

.1 Up to 300mm: 0.6mm

.2 300mm to 760mm: 0.8mm

.2 Round: Mechanically locked flat seam to SMACNA. Thickness as Follows;

.1 Up to 300mm: 0.6mm

.2 300mm to 760mm: 0.8mm

.4 Joints: to SMACNA. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

.5 Fabrication:

.1 Complete metal ducts with themselves with no single partition between ducts. Where width of duct exceeds 450 mm cross break for rigidity. Open corners are not acceptable.

.2 All duct connections to be with fabricated fittings.

.3 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior

.4 Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible. Maximum divergence upstream of equipment to be 30 degree and 45 degree convergence downstream

.5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled

.6 Reinforce door frames with angle iron tied to horizontal and vertical plenum supporting angles. Install hinged access doors where shown, specified or where required for access to equipment for cleaning and inspection.

2.6 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA :

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

.4 Attachments to be reviewed and approved by Seismic Engineer.

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with referenced standard. Construct and install ductwork to suit.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond insulated duct]..

.3 Support risers in accordance with SMACNA ..

.4 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.5 Install breakaway joints on ducts under 300mmm and access door in ducts above 300mm diameter on either side of fire separation.

.6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.7 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.8 Confirm routing of all ductwork at the site and site measure ductwork prior to fabrication. Note that duct dimensions may be revised to suit site routing and building element requirements if dimension revisions are reviewed with and approved by the Departmental Representative. Duct dimension revisions are not considered grounds for an extra cost.

.9 Use flange connected ductwork to hot water heating coils. Support coils independently of ductwork.

.10 Support horizontal rectangular ducts inside the building with trapeze hangers in accordance with SMACNA. All materials to be galvanised construction.

.11 Coordinate with TAB agent for the necessary provision to complete TAB. Include required straight duct runs, balancing dampers, access and clearances.

.12 Apply sealant by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant will be rejected and must be repaired at contractor's expense.

.13 Rigidly construct metal ducts with joints mechanically airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk all duct joints and connections with sealant as ducts are being installed. Seal seams on fresh air and exhaust ducts watertight with mastic or high velocity duct sealant

.14 Ducts with a dimension of 600mm and larger and located in mechanical equipment room or concealed equipments spaces are to be equipped with hanger rods equipped double deflection neoprene rod isolation hangers sized for the associated load.

.15 Proper sized opening shall be arranged for in the correct locations through all slabs and wall. Opening shall include required framing to accommodate fire dampers and access as required.

.16 Fabricate ductwork from field measurements and not from plans and shop drawings exclusively. Failure to do so will not constitute an extra to the Contract

.17 Provided roof curbs with flashing and counterflashing on all duct penetrations. Coordinate work with Div. 1.

.18 All roof mounted ductwork shall have standing seams and shall be sealed weather tight.

.19 Grade ductwork handling moistures at 1:120 back to source.

.20 Arrange ductwork and plenum so that duct and plenum mounted equipment can be accessed for maintenance and removed.

.21 Ducts passing through non-rated partitions shall be tightly fitted and sealed on both sides with silicon acoustical sealant as per Div.1

.22 Protect ductwork openings during constructions from dust infiltration. Any unprotected ductwork to be cleaned prior to substantial.

3.2 DUCTWORK ROUTING AND REVIEW

.1 Duct work routing as shown on drawings is schematic. Provide all necessary ductwork offsets and fitting in order to route ductwork as indicated within the mechanical drawings.

.2 Verify ductwork routing by review of mechanical and structural steel/architectural drawings prior to ordering and shipping major ductwork elements

.3 Where a minor conflict between ductwork and other mechanical or electrical services occurs the conflict is to be resolved by rerouting the service that requires the lesser amount of work at no additional cost to the Owner

.4 Where a conflict between ductwork and the building structural elements occurs that could have been identified prior to ordering and shipping the duct work elements provide the required remedial work at no additional cost to the Owner.

3.3 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA and as follows:

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

3.4 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA.

.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

.3 Apply sealant by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant will be rejected and must be repaired at contractor's expense.

.4 Duct tapes as sealing method are not permitted

.5 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding

.6 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

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

1.3 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 air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

.5 Balancing Dampers

.6 Air Flow Valves and Control Dampers

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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect air duct accessories from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

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

.2 Access doors shall be ULC labelled.

.3 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with SMACNA Duct Manuals.

.4 All materials and compenents to be installed in accordance with the National Building code of Canada (latest edition).

2.2 FLEXIBLE CONNECTIONS

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

.2 To CAN/ULC-S109

.3 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 or foam rubber.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.

2.4 BALANCING DAMPERS

.1 Fabricate of galvanized steel, minimum 1.6 mm. Full blade-length shafts of hollow square construction with blades rigidly fastened along entire blade length

.2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to 400 mm deep and on accessible round ducts

.3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425 mm and over in depth and on all inaccessible rectangular and round ducts

.4 On rectangular ducts up to 275 mm deep construct of single blade (butterfly) type

.5 On rectangular ducts 300 mm to 400 mm deep construct of two opposed blades mechanically interlocked with pivots at quarter points

.6 On rectangular ducts over 425 mm deep construct of multiple opposed blades, mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced

.7 On round ducts construct of single blade (butterfly) type. On 500 Pa class and on all dampers over 300 mm diameter fabricate with full blade-length shaft

.8 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles

.9 Provide over-ride limiting stops on all operating mechanisms

.10 Identify the air flow direction and blade rotation and open and close positions on operating mechanism

.11 On round ductwork, install operating mechanism on a steel mounted base firmly secured to the ductwork

.12 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism

2.5 ALUMINIUM INSULATED AND THERMALLY BROKEN DAMPERS

.1 Frame: extruded 6063T5 aluminum, 2.03 mm thick, 101.6 mm deep, insulated with Styrofoam on three sides for duct mounting and four sides for flanged mounting.

.2 Blades: extruded 6063T5 aluminum, internally insulated with expanded polyurethane foam, thermally broken, minimum insulation value 0.4RSI

.3 Blade and Frame Seals: extruded silicone secured in integral slot with aluminum extrusions

.4 Bearings: celcon inner bearing, 11mm aluminum hexagon blade pin, polycarbonate outer bearing

.5 Linkage: frame side, aluminum and corrosion resistant zinc plated steel with slip proof cup-point trunion screws. Blade linkage hardware to be installed out of air-stream

.6 Jack Shaft Assemblies: to be provided for multiple damper installations

.7 Operating Temperature Range: -40°C to 100°C

.8 Leakage: 25 L/s/m2 at 1 kPa differential static pressure at -40°C

.9 Pressure Drop: full open 1200 x 1200 damper not to exceed .007 kPa at 5.08 m/s

.10 Certification: AMCA 511

.11 Schedule: All E/A and O/A isolation and control dampers

2.6 COMBUSTION AIR ISOLATION DAMPER

.1 Motorized combution air control damper, steel damper blade with nylon bearings, blade seal and intake screen.

.2 Motor: 24V complete with transformer and auxiliary relay for burner control. Interlock with aquastat in acorndance with manufacturers wiring diagram.

.3 Approvals: CSA

.4 Provide optional override and test/run switch.

2.7 TURNING VANES

.1 Factory or shop fabricated single thickness under 400mm, with trailing edge, to recommendations of SMACNA and as indicated.

2.8 AIR FLOW VALVES

.1 Application: air flow valve/regulator and dual volume demand control

.2 Construction: Terminal casing shall be minimum 24-gauge G90 galvanized steel with an integral steel duct collar that allows attachment of both rigid and flexible ducting. The collar shall be sized to allow full insertion of a Constant Airfow Regulator for maximum flow control, but without the regulator extending into attaching duct. All terminals must be listed per UL 507 standards and carry the UL or ETL mark indicating compliance. air flow valve shall include painted aluminum grille and all necessary mounting brackets and hardware

.3 Approvals: cETLus

.4 Control: damper to open/close on signal with spring return

.5 Electrical: 24 VAC, 0.36A when damper open

.6 Dual flow airflow regulators

.1 Provide constant air flow regulator on both minimum and maximum flow rates. Factory preset to specified capacities

.2 The primary air volume mechanism shall be a single-blade damper operated by a long-life 24 VAC, disconnecting type drive motor with permanently lubricated bearings and normally closed spring-return closure. When fully open, the damper shall rotate out of the air stream as a single piece. A permanently fixed perimeter gasket seal shall be provided to prevent air noise and leakage at the closed position. The air flow valve must be capable of overcoming a minimum of 1.0 in. w.g. (250 Pa) of differential pressure across the damper door. The entire damper assembly and all operable components shall be accessible or capable of being removed for maintenance or cleaning through the grille and without disconnecting the duct.

.3 Control device shall respond to changes in duct pressure to maintain the specified flow rate at a constant level. Mechanical damper stops for balancing are not acceptable. Where a maximum flow is indicated, a secondary air flow regualtor shall be installed in the terminal's duct collar.

.4 Operating temperature range -32 to 60degC

.5 Filtration: Provide grease filter on E/A grille in kitchen.

.6 Fabrication UL94V-0 ABS polymer, self-extinguishing

.7 Listings: UL 2043

.8 Accuracy 10% of rated air flow for 24L/s or more air flow and 15% for less

.9 Operating pressure range 50 to 200 Pa low pressure, factory tested and calibrated.

.7 Capacity: as indicated on plans

.8 Acceptable material: Aldes ZRT-2, Greenheck, Lifebreath

2.9 BIRD SCREEN

.1 Heavy Gauge galvanised steel mesh 12mm x 12mm secured in a rigid galvanized steel or aluminium framework. Constructed to be removable.

2.10 FILTERS AND HOUSING

.1 Provide grease filter on kitchen exhaust grilles. see Section 2.8

Part 3 Execution

3.1 INSTALLATION

.1 Flexible Connections:
  .1 Install in following locations:
    .1 Inlets and outlets to supply air units and fans.
    .2 Inlets and outlets of exhaust and return air fans.
    .3 As indicated.
  .2 Length of connection: 100 mm.
  .3 Minimum distance between metal parts when system in operation: 75 mm.
  .4 Install in accordance with recommendations of SMACNA.
  .5 When fan is running:
    .1 Ducting on sides of flexible connection to be in alignment.
    .2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:
  .1 Size:
    .1 600 x 600 mm for person size entry.
    .2 450 x 450 mm for servicing entry.
    .3 300 x 300 mm for viewing.
    .4 As indicated.
    .5 As required to provide servicing
  .2 Locations:
    .1 Control dampers.
    .2 Backdraft dampers.
    .3 Fans.
    .4 Control equipment and sensors.
    .5 Devices requiring maintenance.
    .6 Required by code.
    .7 Reheat coils.
    .8 Every 20m to allow duct cleaning.

.9 Elsewhere as indicated.

.3 Turning Vanes:

.1 Provide turning vanes in ductwork elbows where shown on the drawings and wherever else required where, due to site conditions and installation constraints, duct elbow radius cannot be maintained in accordance with SMACNA requirements.

.2 Install in accordance with recommendations of SMACNA and as indicated.

3.2 FLEXIBLE DUCT CONNECTIONS TO AIR OUTLETS

.1 Install maximum 900 mm length of flexible duct between ceiling diffuser and sheet metal duct with no bend, maximum 20deg offset in between

3.3 CONTROL DAMPERS

.1 Install where indicated

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions

.3 Install access door adjacent to each damper

.4 Ensure dampers are observable and accessible

.5 Allow for installation of damper motors on outside of ducts. Do not locate in outside air stream

3.4 AIR FLOW VALVES

.1 Install to manufacturers recommendations

.2 Provide access doors as required to allow serving, adjustment and removal. Coordinate with Div. 22 and Div.1 for installation.

.3 Ensure straight duct requirements up and down stream of valves are maintained

.4 Provide control power for powered devices

.5 Adjust to meet air balancing requirements

.6 Sizing to manufacturers sizing recommendations for scheduled air flow

3.5 BALANCING DAMPERS

.1 Install balancing dampers at all branch ducts on low pressure supply, return and exhaust air distribution ductwork and where indicated on drawings

.2 Provide single blade dampers for duct sizes to 240 mm x 760 mm. Provide multi-blade opposed blade dampers with maximum blade size at 150 mm x 1800 mm

3.6 COMBUSTION AIR DAMPER

.1 Install damper in vertical orientation in close proximity ot the burner. Secure to wall. Provide one per burner.

.2 Wire damper end switch in series with heater aquastat as per manufacturers wiring diagram

.3 Coordinate with Div 26 for installation and wiring of damper.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts

1.2 REFERENCE STANDARDS

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

- .1 AMCA Publication 201-02 (R2011), Fans and Systems.
- .2 ANSI/ASHRAE 51-16 (ANSI/AMCA 210-16), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 ANSI/AMCA Standard 300-2014, Reverberant Room Method for Sound Testing of Fans.
- .4 ANSI/AMCA Standard 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 AMCA Publication 302-73 (R2012), Application of Sone Ratings for Non-Ducted Air Moving Devices.
- .6 AMCA Publication 303-79 (R2012), Application of Sound Power Level Ratings for Fans.

1.3 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 domestic fans and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

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

1.5 DELIVERY, STORAGE AND HANDLING

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

.2 Storage and Handling Requirements:

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

.2 Store and protect domestic fans from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 KITCHEN RANGE HOOD

.1 Under cabinet design, single blower, dishwasher safe baffle filters, grease drip tray single internal blower, variable speed control, heat sentry auto excessive heat blower speed control, integral BDD suitable for vertical or horizontal duct connections.

.2 Width: 762mm

.3 Lighting: 2 LED modules, 5.5W

.4 Approvals: cULus

.5 Power: 120V/1ph/60Hz, 5.5A

.6 Control: internal relay wiring for remote start of makeup air

.7 Performance: 200 L/s at 370 Pa, 1.5 Sones at low speed or 70 L/s

.8 Acceptable material: Broan E64000 Series, Bosch, Whirlpool

2.2 ENERGY RECOVERY VENTILATOR

.1 Construction:

.1 Fabricate unit with double wall galvanized panels secured with mechanical fasteners. All access doors shall be sealed with permanently applied bulb-type gasket.

.2 Modular sections shall be fabricated with a minimum of 20 ga galvanized steel. System designed for multiple installation configurations for ease of installation.

.3 Access Doors shall be flush mounted to cabinetry, with minimum of two hinges, locking latch and full size handle assembly.

.4 The complete unit is to be suitable for installation in seismic location. Provide intermediate structures and bracing as required.

.2 Fans:

.1 Provide direct-drive backward inclined supply and exhaust blowers with multiple speed ECM motors and built in Class F thermal protection. Additional protection for blocked rotor, overcurrent, under/over voltage and abnormal speed shall also be provided

.2 Fans shall be configured for low and high-speed operation Continuous low speed operation with dry contact closure for high speed from a remote signal.

.3 Electrical

.1 The air handler(s) shall bear an ETL listing label for the entire assembly. Units with only components bearing third party safety listing are unacceptable

.2 Air handler manufacturer shall provide controls to enable the unit, enable heat recovery or free cooling mode, and enable blower high speed through the use of dry contacts. Relay outputs for operating status and furnace interlock shall be provided. BMS integration shall be through these dry contacts

.4 Controls

.1 Controls: PLC based, to include self diagnostics and PLC error code. On board fault detection and diagnostics that senses and alerts when the damper or fans are not operating correctly

.2 LCD based operating interface to the PLC

.3 Minimum three internal temperature sensors; supply air, exhaust air and outdoor air

.4 PLC based controller to allow for unit start/stop, status, alarm and damper and fan speed control for standalone operation of the ERV

.5 Control operation to include for the following damper control features through the PLC

.1 Heat recovery when EAT < 20degC with 60 second defrost damper cycling. Damper cycle frequency to be adjustable

.2 Economizer cooling when E/A >20degC and supply air >15degC

.3 Heat recovery when E/A >20degC and supply air <15degC and then revert to economizer cooling when S/A >15degC

.4 Two speed supply and exhaust fan speed control enabled by remote signal

.5 Fan start/stop

.6 Unit status including alarm

.6 PLC control to include for a minimum of three (3) digital inputs and three (3) digital outputs isolated from the main supply by a reinforced insulation. The I/O shall be suitable for remote control of the ERV without additional connection to digital communication systems. The I/O shall be factory preconfigured to execute the following unit operation through the PLC:

.1 Start (DI): used to start/stop the ERV from remote time clocks and timed over ride switches.

.2 Supply Fan Speed (AI): configured to adjust the ERV supply fan speed.

.3 Return Fan Speed (AI): configured to adjust the ERV supply fan speed.

.4 Run status (DO): configured to identify unit on at remote panels.

.5 Unit Fail status (DO): configured to identify unit trouble at remote panels.

.6 Damper Fail status (DO): configured to identify damper failure.

.7 Filters:

.1 Secondary filter section access for replacing filters

.2 Filter media shall be UL 900 listed, Class I or Class II

.3 2”, 50 mm deep pleated MERV 13 panel filter for supply air stream

.8 Energy Recovery

.1 Dual Core Energy Recovery

.2 Unit shall be equipped with Dual Core energy recovery technology. The unit shall be 90% efficient (sensible +-5%) at equal airflow in winter and up to 80% sensible in summer. A daily 30 min condensation control cycle shall be integrated to maintain performance in extremely cold operation conditions. Devices employing defrost cycles that bypass the

energy recovery device, or reduce the effectiveness are not acceptable. Energy recovery device shall not require frost protection in applications down to -40 degrees.

.3 Energy Cores shall be Generation 3, comprised of precisely corrugated 0.7mm (0.0276") thick 1100 Series aluminum. Thinner aluminum is unacceptable to prevent deformation should cleaning be required to maintain indoor air quality. Spacing between plates shall be minimum 9 mm (0.35") to assure that frost growth will not restrict airflow or reduce performance. Heat exchangers shall be a minimum or 1000 mm (39") long to assure minimum 60 second dwell time. Time between switchovers shall be minimum 60 seconds. Technologies employing shorter heat exchangers are not acceptable due to high cross leakage, and excessive cycling. Maximum allowable face velocity across heat exchangers shall be 490 fpm. Heat exchanger face velocities exceeding 490 fpm are not acceptable

.4 Unit Cross-leakage shall be maximum 1-3% as defined and tested in accordance with ASHRAE 84 Test Methods. Cross leakage exceeds this amount is unacceptable. Manufacturer shall produce testing data reflecting this performance in accordance with ASHRAE 84 test method. Testing must use the tracer gas method prescribed by ASHRAE 84

.5 Switchover damper section shall be comprised of a single blade operated by fast acting electric actuator. In energy recovery mode the Damper switchover must be 1 sec or less. This switchover must limit any internal cross leakage below 3%. Longer switch over times are unacceptable. Pneumatic actuators are not acceptable. Test report must be provided showing that the damper configuration meets this requirement. Testing must use the tracer gas method prescribed by ASHRAE 84

.6 Recovery cycles shall be controlled by internal programmed thermostats measuring both supply and exhaust air and optimizing performance of both heat recovery and free cooling modes

.7 Unit to be provided with optional dedicated path damper section to maintain airflow through intake and exhaust ductwork in a single direction. Unit to be complete with all controls, interlocks and programming for damper operation from integral PLC

.9 Power

.1 Each unit to be fully factory wired and tested. All wiring shall be color coded. All internal power wiring shall be wired in BX cable. A non-fused disconnect shall be prewired on each fan or combination of fans to provide single point power connection for both the supply and return/exhaust fans. Control power to be 120V/1ph/60Hz or 24VAC. Provide numbered terminal strip for field connections

.10 ERV-1;

.1 Capacity:

.2 Low Speed Ventilation Rate: 45 L/s @ 150Pa

.3 High Speed Ventilation Rate: 85 L/s @ 210 Pa

.4 Recovery: Min 91% Sensible

.5 Discharge Air Temp at Design Condition: 14C

.6 Basis of Design: Temp Eff RGSP-K 200

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 domestic fan installation in accordance with manufacturer's written instructions.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ENERGY RECOVERY VENTILATOR

.1 Assembly:

.1 Modules are to be constructed factory assembled and tested. Dismantle for shipping and lifting. Clearly label all parts for assembly

.2 Seal piping or conduit passing through the unit casings to prevent air or water leakage, and isolate to prevent vibration transfer

.2 Pipe units to permit coil removal

.3 Install units with intermediate structure for suspended installations

3.3 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.

.2 Perform start-up activities as directed by manufactuer and as follows;

.1 Purpose: to confirm that the AS units function in accordance with all contract requirements prior to commencing on site start-up activities

.2 Correct all defects when they occur.

.3 Confirm in writing to Departmental Representative successful completion of startup. Provide list of any outstanding deficiencies

.1 Bear signature of technician and supervisor (where applicable).

.4 Startup to include:

.1 Lubricate all bearings as recommended by manufacturer

.2 Vacuum all AHU clean prior to operating fans

.3 Ensure filters are installed. Do not operate systems without filters installed

.4 Ensure all coils are operational and correct capacities are being achieved during operation

.5 Startup and operation of all controls including operation of all sequences, reports, special control algorithms, diagnostics, software

.1 System to operate at AEL of at least 99 % for operating period

.2 In event of failure to attain specified AEL during startup period, extend startup period on day-to-day basis until specified AEL is attained

.3 Unit Dimensions and Cost:

.1 Unit dimensions and motor sizes are provided based on Tempeff. If unit dimensions, weights or motor sizes differ from specified and scheduled materials advise Departmental Representative

.2 Additional payments for changes to building structure, housekeeping pad dimensions, sheet metal changes or electrical services will not be entertained due to changes in unit dimensions, weights and sizes from the specified product

.3 Where modular units from the manufacturers line are of insufficient capacity to meet the specified performance, custom manufacture units of equivalent or greater performance are an acceptable alternate

.4 Construction Use of ERVs;

.1 Construction use of units for ventilation, heating, de-humidification, humidification, dust control or any other use is strictly prohibited

.2 Startup of the ERU can only occur after all ducts installed **and cleaned and building and systems are complete** to the pre-requisite requirements for commencing testing adjusting and balancing as specified in Section 23 05 93

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

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 diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

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

2.2 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as directed by Division 1. Confirm prior to ordering.

.5 Base outlet application on space noise level as outlined in SOR.

.6 Check ceiling compatibility and mounting instructions prior to ordering.

.7 Manufacturer shall match specified performance data and indicate comparisons for each product.

.8 All ceiling mounted air diffusers to be seismically restrained in accordance with Section 23 05 48.

.9 Provide concealed baffles where necessary to direct air away from wall, columns and other obstructions in the radius of air terminal.

2.3 MANUFACTURED UNITS

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

2.4 WALL HOODS

.1 Thickness: to ASHRAE and as indicated on drawings whichever is more stringent.

.2 Fabrication: to ASHRAE and as indicated on drawings whichever is more stringent

.3 Joints: to ASHRAE. Proprietary manufactured flanged duct joint shall be considered to be a class A seal. and as indicated on drawings whichever is more stringent

.4 Complete with integral bird screen of 2.7 mm diameter SS wire. Use 12 mm mesh on exhaust.

.5 Vertical backdraft dampers and control dampers as indicated on drawings

.6 Finish:

.1 Wall Hoods: Shop primed and painted finish as per Division 09

.2 Goose Necks: Shop primed and painted finish as per Division 09

2.5 RESIDENTIAL GRILLES, REGISTERS AND DIFFUSERS

.1 Supply and return air grilles and registers:

.1 Aluminum, clear anodized finish, adjustable volume control core, concealed mounting spring.

.1 Acceptable Material: Seiho JRC, Price, Greenheck

.2 Kitchen exhaust air grilles:

.1 Steel construction, painted white finish, hinged louvered face, integral grease filter rack with washable aluminium filter, concealed mounting spring.

.1 Acceptable Material: Lifebreath EasyAir Kitchen Grille, Price, Greenheck

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Make airtight connection between diffusers and ductwork.

.3 Provide balancing damper on duct take-off to each diffuser at main branch take-off, even when volume dampers are specified as part of grille assembly

.4 Sizes indicated are nominal. Provide correct standard product nearest to nominal to deliver the capacity listed without increasing noise levels or pressure drop

.5 Arrange to paint ductwork visible behind air outlets matte black. Refer to Section 20 05 53, Identification for HVAC Piping and Equipment

.6 Install with flat head screws in countersunk holes where fastenings are visible.

.7 Where kitchen grille is located within 3m of range, provide grease filter on exhaust intake.

.8 Confirm air outlet/inlet and louvre dimensions, mounting, finish and colours with ceiling and wall construction prior to submitting shop drawings

.9 Adjust supply outlets to deliver air patterns defined on drawings or as directed by the Departmental Representative

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 ASTM International (ASTM)

.1 ASTM E90-16, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

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

.5 Society of Automotive Engineers (SAE)

1.3 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 louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

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

Part 3 Execution

3.1 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Coordinate with GC for framing and air sealing requirements.

.4 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

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

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S629-M87 - Standard for 650 Degrees C Factory-Built Chimneys

.4 CSA Group (CSA)

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

1.3 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 chimneys and stacks and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate following:

.1 Draft Calculation sheet

.2 Methods of sealing sections.

.3 Methods of expansion.

.4 Details of thimbles.

.5 Bases/Foundations.

.6 Supports.

.7 Guy details.

.8 Rain caps.

1.4 QUALITY ASSURANCE

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

.2 Vents and Venting Systems: Labeled by Underwriters' Laboratory of Canada

.3 Comply with CSA B139 Series 19: Installation Code of Oil Burning Equipment

.4 Comply with the National Building Code

.5 Comply with requirements of Appliance Listing

Part 2 Products

2.1 ALL FUELS CHIMNEY AND BREECHING

.1 General: sectional, stainless steel construction, double wall, expansion compensating without the requirement of bellows, factory built, ULC labeled, rated to 760 degrees C for natural draft appliances

.2 Seal: twist lock construction. Double lapped seams,

.3 Approval: ULCS-629M

.4 Insulation

.1 HW Boilers and DHWH: 50 mm thickness high temperature mineral wool insulation.

.5 Liner: type 304 stainless steel

.6 Shell: type 304 stainless steel

.7 Couplings: mated couplings with collar.

.8 Fittings for each chimney:

.1 Base lateral tee with cap and drain

.2 Barometric pressure regulator.

.3 Rain Cap

.4 Roof flashing, collar and roof brace

.5 Radiation shields at each floor penetration

.6 Base and intermediate supports as required

.9 Acceptable Material: Security Chimney S2100+, Duravent, Selkirk

2.2 ACCESSORIES

.1 Cleanouts: bolted, gasketted type, full size of breeching area.

.2 Barometric Damper: double acting sized to 70% of full size of breeching area where indicated.

.3 Appurtenances

.1 Rain Cap

.2 Base tee with drain

.3 Thimbles and, support brackets and guys, flashing and counterflashings, and other materials required to complete the assembly

Part 3 Execution

3.1 INSTALLATION - GENERAL

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

.2 Suspend breeching at 1.5 m centres and at each joint.

.3 Support chimneys at bottom, roof and intermediate levels as indicated. Provide supp,emetnal support where length exceeds manufacturers recommended spacing.

.4 Provide detailed shop drawings and parts list

.5 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.

.6 Install flashings on chimneys penetrating roofs, as indicated.

.7 Install rain caps and cleanouts, as indicated.

3.2 VENT INSTALLATION - ALL FUEL CHIMNEY

.1 Install vents, complete with accessories and appurtenances, in accordance with CAN/CSA B139-Series 19, National Building Code of Canada, manufacturer's instructions and as follows:

.2 Do not penetrate flue gas chamber of vent with screws or mechanical fasteners

.3 Install breeching with positive slope upward from appliance.

.4 Suspend breeching using trapeze hangers at 1500 mm centers.

.5 Install base tees with cleanout at base of chimney. Direct connection to appliances with out base tees is not acceptable

.6 Install drain tee cap (TD) at base of chimney

.7 Provide breeching damper as required by manufactuer

.8 Support chimney at bottom, roof and intermediate levels and as direted by manufacuter.

.9 Install thimbles where penetrating roof, floor and ceiling

.10 Install counterflashing where chimneys pass through roof

.11 Provide for expansion and contraction of chimney and breeching

.12 Provide Type A chimney for full length of vertical chimney and from appliances. Use of field fabricated breechings or breeching connectors is not acceptable.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code, 2021.

.3 CSA Group (CSA)

.1 CSA B51-19, 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 Shop Drawings:

.1 Shop drawings to indicate project layout, including layout and dimensions of heat exchangers and system.

.1 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.

.4 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.

Part 2 Products

2.1 BRAZED PLATE HEAT EXCHANGER

.1 Brazed Plate Heat Exchanger

.1 Water to glycol;

.1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code and CSA B51

.2 Plates: 316, stainless steel, fully supported and brazed with copper. Flow to be arranged in pure counterflow arrangement and capped with SS endplates

.3 Supports: as indicated and with factory secured seismic restraint connections, support in accordance with Section 23 05 48

.4 Piping connections: as indicated

.5 HEX-1:

.1 Service: Heating

.2 Capacity: 9.3kW

.3 Source:

.1 Fluid: Water

.2 EWT: 60C, LWT: 50C

.3 Maximum Fluid Pressure Drop: 0.8m

.4 Flow: 0.225 L/s

.4 Load:

.1 Fluid: 30% Propylene Glycol

.2 EWT: 45C, LWT: 55C

.3 Maximum Fluid Pressure Drop: 0.8m

.4 Flow: 0.234 L/s

Part 3 Execution

3.1 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 Install level and firmly anchored to supports in accordance with manufacturer's recommendations

.3 Connect piping as per drawings. When installation is complete and piping has been permanently filled, start-up each heat exchanger, check and test all safeties and operating controls to design conditions. Check installation, settings, operation of relief valves and safety valves

.4 Ensure air is purged and allowances for balancing are installed and functional prior to start of TAB. Install all thermometer wells and pressure gauges as indicated

3.2 APPURTENANCES

.1 Install with hose bib drain valve and safety relief valve piped to drain as indicated.

.2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

3.3 SYSTEM START-UP

.1 General: perform start-up operations in accordance with Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems: 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 Timing: only after TAB of hydronic systems have been successfully completed.

.7 Primary side:

- .1 Control valve: verify proper operation without binding, slack in components. Measure either steam pressure and temperature at control valve inlet or 2 if control is three-port type, pressure drop across inlet to common, bypass to common, inlet to bypass.
- .2 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.
- .3 Calculate heat transfer from primary and secondary sides.
- .4 Simulate heating water temperature schedule and repeat above procedures.
- .5 Reports:
  - .1 In accordance with Section 23 05 93.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

3.5 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 RELATED REQUIREMENTS

.1 This Section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be to the most recent edition.

.2 Institute of Boiler and Radiator Manufacturers (IBR)

.3 US Department of Commerce

.1 CS 140-47, Commercial Standard.

1.3 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 finned tube radiation heaters and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Equipment, capacity, piping, and connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

.3 Special enclosures.

.4 Enclosure temperature

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 finned tube radiation heaters for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturers 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect finned tube radiation heaters from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CAPACITY

.1 As indicated, based on 50 degrees C average water temperature, 11 degrees C temperature drop and 21 degrees C at entering air temperature.

.2 Under the above condition, Surface Temperature shall not exceed 45C

2.2 LOW PROFILE FINNED TUBE RADIATION, RAD-1

.1 Provide steel panel radiator elements of lengths and in locations as indicated, and of capacities, style and having accessories as scheduled.

.2 The wall hung heating panel radiation shall be of one-piece all-welded steel construction, consisting of flattened water tubes welded to headers at each end. The radiator shall include an integral heavy gauge all-welded perforated top grille.

.3 Provide steel corrugated fins welded to the rear side of the water tubes with a minimum of 32 fins per foot.

.4 The radiator's headers shall include all necessary inlet, outlet and vent connections as required. Standard connection sizes are ½" NPT tapered thread for supply and return piping, and NPT 1/8" for the vent connection. Internal baffling is provided where required for proper water flow.

.5 The radiant heating panels shall be available in lengths from 610mm to 8990mm in 50mm even increments without the need for splicing. The panel radiation shall be capable of being mounted to typical stud wall construction without additional blocking or strapping. Support and mounts should either be wall mounting brackets or floor post mounting, as required, and shall be provided with the radiation.

.6 Dimensions for enclosures:

.1 Installed Depth not to exceed 50mm from wall face

.2 Measure site conditions. Do not scale from drawing.

.3 Height: 365mm, Length as indicated

.7 Output: 390W based on a AWT of 50C

.8 Provide for noiseless expansion of components.

.9 Acceptable Products: Runtal RF-5, Jaga, Hudson Reed

2.3 BARE FINNED TUBE RADIATION, RAD-2

.1 Heating elements: NPS 1 1/4 seamless copper tubing, 1.2 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100 x 100 mm nominal, 130 fins per metre suitable for sweat fittings.

.2 Heating elements: NPS 1 1/4 steel tube 3.1 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced steel fins 100 x 100 mm nominal fins, 105 fins per metre.

.3 Element hangers: plastic lined cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.

.4 Standard enclosures: None

.5 Provide for noiseless expansion of components.

.6 Capacity: 317W/m without cabinet.

.7 Standard of Acceptance: Engineered Air WF, Slant Fin, Trane

2.4 HYDRONIC TOWEL WARMER, RAD -3

.1 Steel Construction, painted white finish. Wall mounted with concealed piping connections.

.2 Round bar design, 840mm x 495mm x 106mm size, bars spaced in three groups

.3 Provide all neceesary brackets and hardware for mounted. Coordinate with G.C. for proviiosn of required backing.

.4 Output: 313W based on a 55C input temperature.

.5 Accetpable Material; Runtal Neptune, Hudson Reed, ICO

2.5 LOW PROFILE FINNED TUBE RADIATION, RAD-4

.1 Provide steel panel radiator elements of lengths and in locations as indicated, and of capacities, style and having accessories as scheduled.

.2 The wall hung heating panel radiation shall be of one-piece all-welded steel construction, consisting of flattened water tubes welded to headers at each end. The radiator shall include an integral heavy gauge all-welded perforated top grille.

.3 Provide steel corrugated fins welded to the rear side of the water tubes with a minimum of 32 fins per foot.

.4 The radiator's headers shall include all necessary inlet, outlet and vent connections as required. Standard connection sizes are ½" NPT tapered thread for supply and return piping, and NPT 1/8" for the vent connection. Internal baffling is provided where required for proper water flow.

.5 The radiant heating panels shall be available in lengths from 610mm to 8990mm in 50mm even increments without the need for splicing. The panel radiation shall be capable of being mounted to typical stud wall construction without additional blocking or strapping. Support and mounts should either be wall mounting brackets or floor post mounting, as required, and shall be provided with the radiation.

.6 Dimensions for enclosures:

.1 Installed Depth not to exceed 50mm from wall face

.2 Measure site conditions. Do not scale from drawing.

.3 Height: 736mm, Length as indicated

.7 Output: 687W/m based on a AWT of 50C

.8 Acceptable Products: Runtal RF-10, Jaga, Hudson Reed

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 finned tube radiation convector heater installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Install in accordance with piping layout and reviewed shop drawings.

.3 Locate below fenestrations. At perimeter as indicated

.4 Provide for pipe movement during normal operation.

.5 Maintain sufficient clearance to permit performance of service maintenance.

.6 Check final location with Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.

.7 Valves:

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

.8 Venting:

.1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.

.2 Install automatic air vent on continuous finned tube radiation.

.9 Provide acess panels where required to access vents or isolation.

.10 Check for correct element length in heating cabinet as work progresses. Schedule length is actual finned length.

.11 Field measure for lengths of convector, wall fin or other cabinetry prior to manufacture. Install cabinets and fins including wall supports as recommended by manufacturer.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

GENERAL

1.01 RELATED REQUIREMENTS

1. This section contains clauses which supplement the requirements of the contract and the Division 01 specifications. This section is common to division 26 & 27 specifications, and electrical specifications contained in divison 33. Refer to division 01 for additional requirements.
2. Complimentary documents: the drawings, specifications, and any supplementary schedules and instructions are complimentary to each other. In the event of discrepancy between the documents, seek a ruling from the Consultant prior to proceeding.

1.02 REFERENCES

1. Definitions:
    1. Contract terms and definitions: terms used in these specifications and on the drawings are as defined in the construction contract.
    2. Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
2. Reference Standards:
    1. CSA Group
        1. CSA C22.1, Canadian Electrical Code, Part 1 , Safety Standard for Electrical Installations.
        2. CAN/CSA-C22.3 No.1, Overhead Systems.
        3. CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
    2. National Research Council of Canada (NRCAN)
        1. National Building Code of Canada
        2. National Fire Code of Canada (NFCC)
    3. Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
        1. IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms.
    4. Conformance with NFPA 70E-2021.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

1. Submit in accordance with Section 01 33 00 - Submittal Procedures, and as follows:
2. Product Data:
    1. Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
3. Submit for review electrical single line diagrams under plexiglass and locate at the main electrical distribution point and as indicated.
4. Shop drawings:
    1. Submit drawings stamped and signed by the general contractor, the electrical subcontractor, and (where applicable) the specialty subcontractor. The review of these documents is to be made by someone who is qualified and knowledgeable about the project. The Consultant reserves the right to reject any submission that does not meet this criteria.
    2. Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
    3. Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

4. Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
5. If changes are required, notify Consultant of these changes before they are made.

5. Certificates:
   1. Submit test results of installed electrical systems and instrumentation.
   2. Permits and fees: in accordance with General Conditions of contract.
   3. Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
   4. Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant .

1.04 CLOSEOUT SUBMITTALS

1. Submit in accordance with Section 01 78 00 - Closeout Submittals and as follows:
2. Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
   1. Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
   2. Operating instructions to include following:
      1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
      2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
      3. Safety precautions.
      4. Procedures to be followed in event of equipment failure.
      5. Other items of instruction as recommended by manufacturer of each system or item of equipment.
   3. Print or engrave operating instructions and frame under glass or in approved laminated plastic.
   4. Post instructions where directed.
   5. For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
   6. Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.05 DELIVERY, STORAGE AND HANDLING

1. Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 a secure, clean, dry location. Storage temperatures and humidity to be maintained to prevent any damages.
   2. Store and protect from nicks, scratches, and blemishes.
   3. Replace defective or damaged materials with new.
4. Materials are to be insured at all times while in transport and storage. Where site conditions prevent the storage of materials, arrange for suitable off site storage.

PRODUCTS

2.01 DESIGN REQUIREMENTS

1. Operating voltages: to CAN3-C235.
2. Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
    1. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
3. Arc flash:
    1. All sytems to be compliant with relevant arc flash protection code and standards (NFPA70E, Z462).

2.02 MATERIALS AND EQUIPMENT

1. Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements and as follows:
2. Materials and equipment to be CSA certified and bear the markings of a testing agency recognized by the Standards Council of Canada (SCC). Where CSA certified material and equipment are not available, obtain required approvals from a listed field testing agency. Pay all costs for obtaining 3rd party approvals. Submit copies of field testing certification for review, prior to delivery of products to site.
3. Factory assemble control panels and component assemblies.

2.03 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

1. Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.04 WARNING SIGNS

1. Warning Signs: in accordance with requirements of authority having jurisdiction and Consultant .
2. Decal signs, minimum size 175 x 250 mm.

2.05 WIRING TERMINATIONS

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

2.06 EQUIPMENT IDENTIFICATION

1. Identify electrical equipment with Nameplates as follows:
    1. Nameplates: lamicoid, 3 mm thick plastic, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
    2. Sizes as follows:

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

2. Wording on Nameplates to be approved by Consultant prior to manufacture.
3. Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
4. Disconnects, starters and contactors: indicate equipment being controlled and voltage.

5. Terminal cabinets and pull boxes: indicate system and voltage.
6. Transformers: indicate capacity, primary and secondary voltages, fed from " ", and winding configuration.
7. Language operating requirements: provide identification Nameplates for control items in English. Use one Nameplate for each language.

2.07 WIRING IDENTIFICATION

1. Identify wiring with permanent indelible identifying markings, on both ends of phase conductors of feeders and branch circuit wiring.
2. Maintain phase sequence and colour coding throughout.
3. Colour coding: to CSA C22.1.
4. Use colour coded wires in communication cables, matched throughout system.

2.08 CONDUIT AND CABLE IDENTIFICATION

1. Colour code conduits, boxes and metallic sheathed cables.
2. Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

2.09 FINISHES

1. Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
    1. Paint outdoor electrical equipment "equipment green" finish. Stainless equipment to be left with stainless finish.
    2. 120/240V indoor switchgear and distribution enclosures to be light gray colour.

EXECUTION

3.01 EXAMINATION

1. Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
    1. Visually inspect substrate in presence of Consultant .
    2. Inform Consultant of unacceptable conditions immediately upon discovery.
    3. Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant .

3.02 INSTALLATION

1. Do complete installation in accordance with CSA C22.1 except where specified otherwise.
2. Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.03 NAMEPLATES AND LABELS

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

3.04 CONDUIT AND CABLE INSTALLATION

1. Install conduit and sleeves prior to pouring of concrete.
    1. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm. Where conduit passes through foundation walls, or extends beyond the building footprint below slab-on-grade construction, sleeves are to protrude 450mm beyond the building footprint.
2. If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

3. Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.05 LOCATION OF OUTLETS

1. Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings, and as follows.
2. Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
3. Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.
4. Locate light switches on latch side of doors.
    1. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.06 MOUNTING HEIGHTS

1. Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
2. If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
3. Install electrical equipment at following heights unless indicated otherwise.
    1. Local switches: 1150 mm.
    2. Local control devices such as thermostats: 1150mm.
    3. Panelboards: as required by Code or as indicated. Topmost breaker not to exceed 1800mm.
    4. Structured Wiring Outlets: 450 mm or as indicated.
    5. Television outlets: 450 mm or as indicated.
    6. Wall mounted lighting: as indicated on lighting drawings.
    7. Wall receptacles:
        1. General: 400 mm or as indicated.
        2. Above top of continuous baseboard heater or hydronic heater: NOT PERMITTED
        3. Above top of counters or counter splash backs: 175 mm.
        4. In mechanical rooms: 1200 mm.

3.07 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.08 FIELD QUALITY CONTROL

1. Load Balance:
    1. Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
    2. Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
    3. Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
2. Carry out tests in presence of Consultant .
3. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

4. 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 - ACTION AND INFORMATIONAL 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.

3.09 SYSTEM STARTUP

1. Instruct Owner forces and Consultant in operation, care and maintenance of systems, system equipment and components.
2. Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.10 CLEANING

1. Progress Cleaning: clean in accordance with Section division 01 requirements.
    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 Division 01.

END OF SECTION

GENERAL

1.01 PRODUCT DATA

1. Provide shop drawings and manufacturer data sheets for specialty cables (VFD Rated Cables, cables to be installed in Hazardous locations or corrosive environments, or combination power/controls cables).

PRODUCTS

2.01 APPLICATION

1. Do not use wires or cables for any application other than as permitted by CSA C22.1 .
2. Wiring to be type NMD90 or approved equivalent except where indicated otherwise in these documents.
3. Provide single conductor building wire in raceway unless otherwise indicated or permitted by these documents.

2.02 GENERAL REQUIREMENTS

1. Conductor Material:
    1. Conductors to be copper unless aluminum is specifically indicated. Substitution of copper conductors with aluminum is not permitted. Conductor sizes shown are based on copper unless specified otherwise.
2. Minimum conductor sizing:
    1. Conductors to be minimum #14 AWG throughout.
        1. Where conductor sizing is not shown, size conductors in accordance with CSA C22.1 , including applicable derating factors and voltage drop.
    2. Conductor Colour Coding:
        1. For single phase power systems: Red, Black, White
        2. For three phase power systems; Red, Black, Blue, White
        3. Bonding conductors past the main ground buss: Green insulated.
3. Conductors and cables installed outdoors, or where exposed to sunlight, to be sunlight resistant.

2.03 NMD90 WIRING

1. Copper with suitably size bond.
2. White sheath
3. For use as permitted by applicable building and electrical codes in combustible construction.

2.04 SINGLE CONDUCTOR BUILDING WIRE

1. Conductors (unless otherwise shown or specified): copper, stranded for 10 AWG and larger. Minimum size: 12 AWG.
2. Insulation: cross-linked polyethelene XPLE, with 600V insulation rating, temperature rated RW90 non-jacketted.
3. For 600V VFD drive applications: copper conductors, size as indicated 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

2.05 ARMOURED CABLES (AC90)

1. Type AC90 cable and ACWU90 cable.
2. Conductors (unless otherwise shown or specified): copper, stranded for 10 AWG and larger. Minimum size: 12 AWG.
3. Insulation: Cross linked polyethelene XLPE, with 600V insulation rating, temperature rated RW90 non-jacketted.
4. Armour: interlocking type fabricated from aluminum strip.

5. (ACWU90) Exterior sheath: PVC jacket over armour, FT4 rated, and listed for wet locations.
6. Connectors: anti short bushings listed and compatible with cabling.

2.06 TECK 90 CABLE

1. Conductors (unless otherwise shown or specified): copper, stranded, minimum size: 12 AWG. Bonding conductors may be aluminum.
2. Insulation: Cross linked polyethelene XLPE, with 600V insulation rating, temperature rated RW90 non-jacketted.
3. Where PV systems are less that 600V, 600V teck may be used. Cables to be UV rated.
4. For 600V VFD Drive applications: use minimum 1000V insulation rating.
5. Inner jacket: continuous PVC jacket.
6. Armour: Interlocking aluminum.
7. Overall covering: thermoplastic polyvinyl chloride, FT4 rated, Oil Reistant, sunlight resistant.
8. HL Rated where installed in hazardous locations.
9. Nexans, Southwire, Northern cables or equal.
10. Connectors:
    1. Dry type for general use in Type 1 environments, and where entering through the bottom of cabinets in type 1x (sprinklered), and type 3 environments .
    2. Watertight for all other environments.
    3. Explosion-proof for hazardous locations:
        1. To be rated Class I Div I for any hazardous locations.

2.07 CONTROL CABLES

1. Type: FAS/LVT 105: soft annealed copper conductors. FT4 rated sheath, 300V insulation.

EXECUTION

3.01 GENERAL CABLE INSTALLATION

1. Do not apply paint to cables. This can alter the fire resistance rating of the cable.
2. Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
3. Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
4. Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.02 INSTALLATION OF TECK90 CABLE (0 -1000 V)

1. Group cables wherever possible on channels.
2. Install cable exposed, securely supported by p-clamps on unistrut.

END OF SECTION

GENERAL

1.01 REFERENCE STANDARDS

1. American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
    1. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earch Surface Potentials of a Grounding System.
2. CSA Group (CSA)
    1. CSA C22.1 Section 10 - Grounding and Bonding
    2. CSA C22.2 No. 41 Grounding and Bonding Equipment

1.02 ACTION AND INFORMATIONAL SUBMITTALS

1. Submit in accordance with Section 01 33 00- Submittal Procedures and as follows:
2. Product Data:
    1. Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.03 CLOSEOUT SUBMITTALS

1. Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.
2. Submit grounding test results.

PRODUCTS

2.01 EQUIPMENT

1. Ground Electrodes
    1. Ground Rod:2X Copper clad steel, 17.3mm (3/4") diameter, 3M (10') long. Knurled end.
        1. Sectional rods as indicated. Provide couplings and driving studs to facilitate installation.
        2. Ground Rod Inspection Cover: Hot dipped galvanized steel, 250mm diameter, 300mm depth. removable top, minimum #10 AWG.
            1. Thomas and Betts Ground Electrode Box or equal.
2. Ground Conductors
    1. Bare, stranded copper, sized as follows unless noted otherwise. Installed to interconnect the system grounding electrodes, and connect to the ground buss and first point of disconnect.
        1. Size as shown on the drawings.
3. Bonding Conductors
    1. Stranded copper, green insulated sheath with cross linked polyethelyne insulation 600V RW90 XPLE, minimum FT4 rated and UV stable.
    2. Sized as indicated for electrical distribution and branch circuiting. Where not indicated, sized to code.
    3. Sized as indicated for bonding of systems. Where not indicated, sized minimum #6 AWG copper.
    4. Installed to interconnect the nearest system ground buss:
        1. Oil and Gas piping: #6 AWG copper.
        2. Oil and Propane storage tanks: #6 AWG copper.
        3. Structural Steel: #3/0 copper. Minimum 2 locations and every 75m (250') of exterior wall.
4. Ground Bussing
    1. High purity copper rectangular bussbars installed on insulated standoffs. Factory double drilled to accept two-hole barrel lug connectors. Size as indicated.

5. Braided Bonding Straps:
    1. Copper braided strap with tinned finish. Sized for application. Where size of bolts are too large for bonding strap, provide metal tab to bolt through.
        1. FBD by Thomas & Betts or equal.
6. Ground Lugs:
    1. Heavy duty two hole NEMA lugs. Sized for application. Compression type, copper.
        1. Type CTL by Blackburn or equal.

EXECUTION

3.01 EXAMINATION

1. Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
2. Inform Consultant of unacceptable conditions immediately upon discovery.

3.02 INSTALLATION GENERAL

1. Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run bond conductor in conduit.
2. Install connectors in accordance with manufacturer's instructions.
3. Protect exposed grounding conductors from mechanical injury.
4. Use mechanical connectors for grounding connections to equipment provided with lugs.
5. Soldered joints not permitted.
6. Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.03 ELECTRODES

1. Install rod electrodes and make grounding connections.
2. Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.04 SYSTEM AND CIRCUIT GROUNDING

1. Install system and circuit grounding connections to neutral of main swtich.

3.05 EQUIPMENT GROUNDING

1. Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.06 GROUNDING BUS

1. Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
2. Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections.

3.07 COMMUNICATION SYSTEMS

1. Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
    1. Telephones: make telephone grounding system in accordance with telephone company's requirements. Typically #6CU bond.

2. Sound, fire alarm, security systems, intercommunication systems as indicated.

3.08 FIELD QUALITY CONTROL

1. Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant .

3.09 RECORD DRAWINGS

1. Show final locations of grounding equipment and electrodes.
    1. Measured locations of buried connections.
    2. As-installed grounding electrode locations and conductor sizing.

END OF SECTION

GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

1. Product Data:
    1. Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

PRODUCTS

2.01 SPLITTERS

1. Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
2. Terminations: connection blocks, main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

2.02 JUNCTION AND PULL BOXES

1. Construction:welded steel enclosure.
2. Covers Flush Mounted: 25 mm minimum extension all around.
3. Covers Surface Mounted: screw-on turned edge covers.
4. Vehicle H20 rated minimum in vehicular areas. Coordinate with civil and structural for final ratings.

EXECUTION

3.01 SPLITTER INSTALLATION

1. Mount plumb, true and square to building lines.
2. Extend splitters full length of equipment arrangement except where indicated otherwise.

3.02 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

1. Install pull boxes in inconspicuous but accessible locations.
2. Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
3. Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

END OF SECTION

GENERAL

1.01 REFERENCE STANDARDS

1. CSA Group (CSA)
    1. CAN/CSA C22.2 No. 18, , Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
    2. CSA C22.2 No. 45, Rigid Metal Conduit.
    3. CSA C22.2 No. 56 , Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
    4. CSA C22.2 No. 83, Electrical Metallic Tubing.
    5. CSA C22.2 No. 211.2 , Rigid PVC (Unplasticized) Conduit.

PRODUCTS

2.01 CONDUITS

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

2.02 CONDUIT FASTENINGS

1. One hole steel straps to secure surface conduits 50 mm and smaller.
2. Two hole steel straps for conduits larger than 50 mm .
3. Beam clamps to secure conduits to exposed steel work.
4. Threaded rods, 6 mm diameter, to support suspended channels.

2.03 CONDUIT FITTINGS

1. Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
2. Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
3. Watertight connectors and couplings for EMT.
    1. Set-screws permitted for type 1 environments.

2.04 FISH CORD

1. Polypropylene.

EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

1. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
2. Conceal conduits except in unfinished areas and in mechanical and electrical service rooms.
3. Use rigid pvc conduit underground.
4. Use Rigid Galvanized Steel conduit
    1. In hazardous areas, including where buried in hazardous areas.
    2. Where subject to mechanical injury.

5. Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
6. Install conduit sealing fittings in hazardous areas, at the boundaries of area classifications and as indicated.
    1. Fill with compound.
7. Minimum conduit size for lighting and power circuits: 19 mm.
8. Bend conduit cold:
    1. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
    2. Machine bend steel conduit over 19 mm diameter.
9. Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
10. Install fish cord in empty conduits.
11. Remove and replace blocked conduit sections.
12. Dry conduits out before installing wire.

3.03 SURFACE CONDUITS

1. Run parallel or perpendicular to building lines.
2. Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
3. Run conduits in flanged portion of structural steel.
4. Group conduits wherever possible on surface channels.

3.04 CONCEALED CONDUITS

1. Run parallel or perpendicular to building lines.

3.05 CONDUITS IN CAST-IN-PLACE CONCRETE

1. Locate to suit reinforcing steel.
2. Protect conduits from damage where they stub out of concrete.
3. Install sleeves where conduits pass through slab or wall.
4. Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
    1. Use cold mastic between sleeve and conduit.
5. Organize conduits in slab to minimize cross-overs.

3.06 CONDUITS UNDERGROUND

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

END OF SECTION

GENERAL

1.01 REFERENCE STANDARDS

1. The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.
    1. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
    2. Federal Specification W-P-115C - Type I Class 1
    3. ASTM - American Society of Testing Materials
    4. IBC – International Building Code – Seismic compliance requirements
    5. NFPA 5000 – NFPA Building Code – Seismic compliance requirements
    6. ASCE 7 – American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures – Seismic compliance requirements
    7. ICC ES AC156 – International Code Council Evaluation Services Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems – seismic testing protocol
2. CSA Group (CSA)
    1. CSA C22.2 No.29 , Panelboards and Enclosed Panelboards.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

1. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.
2. Shop Drawings:
    1. Submit drawings stamped and signed by professional engineer registered or licensed in Nunavut , Canada.
    2. Include on drawings:
        1. Direct from the manufacturer electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.03 QUALIFICATIONS

1. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.

1.04 CLOSEOUT SUBMITTALS

1. Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.05 WARRANTY

1. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of substantial completion.

PRODUCTS

2.01 LOAD CENTERS / COMBINATION GENERATOR BACKUP PANEL

1. Rated for up to 240V.
2. 120/240V single phase, 200A.
3. Main breaker as indicated on the single line diagram.
    1. Standard 22,000 ampere short circuit current rating on main breaker
    2. Branch circuit breakers suitable for 10,000A short circuit rating.

4. Shielded aluminum bus and interior assembly
5. 10 Year Warranty.
6. Schneider, Homeline loadcenter(HOM4080N200PCVP) or approved equivalent.
    1. Approved equivalent acceptable from Eaton and Siemens.

2.02 SURGE SUPPRESSION

1. Voltage: 120/240V
2. Maximum surge current: 80kA
3. Nominal discharge current: 10kA
4. Maximum Continuous Operating Voltage 300V N-G / L-L
5. Connection Method: 2x 12AWG solid wire.
6. Locate in close proximity to panel.
7. Green Status LED
8. Type 1 Surge suppression device.
9. Product Standaard of acceptance: Schneider HEPD80 or approved equivalent.
    1. Approved equivalent acceptable from Eaton and Siemens.

2.03 BRANCH CIRCUIT BREAKERS

1. Provides overload and short circuit protection.
2. Accepts Al/Cu conductors.
3. Accepts 60/75°C wire up to 40 A, 75°C wire over 40 A.
4. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
5. The exposed faceplates of all branch circuit breakers shall be flush with one another.
6. Lugs shall be listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating.
7. Breakers shall be CSA and UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch as noted.
8. Breakers with thermal and magnetic tripping in loadcenter except as indicated otherwise.
9. Lock-on devices for 10 % of 15 to 20 A breakers installed as indicated. Turn over unused lock-on devices to Owner .

2.04 ENCLOSURES

1. Type 1 Boxes
    1. Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvannealed steel is not acceptable.
    2. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
    3. Box width shall not exceed 510mm wide.
2. Type 1 Fronts
    1. Front shall meet strength and rigidity requirements per UL 50 standards. Shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
    2. Fronts shall be hinged 1-piece with door. Mounting shall be as indicated on associated drawings.
    3. Panelboards rated 250 amperes and below shall have MONO-FLAT fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked. Panelboards rated

above 250 amperes shall have vented fronts with concealed door hinges. Doors on front shall have rounded corners; edges shall be free of burrs.

4. Front shall have flat latch type lock with catch and spring loaded stainless steel door pull. All lock assemblies shall be keyed alike. Two (2) keys shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.

EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

1. Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
2. Install surface mounted panelboards on plywood backboards in accordance with other sections. Where practical, group panelboards on common backboard.
3. Mount panelboards to height specified in Section 26 05 00- Common Work Results for Electrical or as indicated.
4. Connect neutral conductors to common neutral bus.
5. Install panelboards in accordance with manufacturer's written instructions.
6. **FIELD QUALITY CONTROL**
    1. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
    2. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
    3. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION

GENERAL

1.01 REFERENCE STANDARDS

1. CSA Group (CSA)
    1. CSA C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
    2. CAN/CSA C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
    3. CSA C22.2 No.55, Special Use Switches.
    4. CSA C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20).

1.02 ACTION AND INFORMATIONAL SUBMITTALS

1. Shop Drawings:
    1. Submit drawings stamped and signed by professional engineer registered or licensed in Nunavut .

1.03 CLOSEOUT SUBMITTALS

1. Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

1. Provide wiring devices suitable for intended use and with ratings adequate for load served.
    1. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
    2. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations and as required by code.
        1. Provide GFCI protection for receptacles installed within 1.8 m of sinks.
        2. Provide GFCI protection for receptacles installed in kitchens.
    3. Provide tamper resistant receptacles for receptacles installed in dwelling units.
2. Finish Details and Locations & Cover plate Details:
    1. Cover plates for wiring devices to: CSA C22.2 No.42.1.
    2. Wiring Devices, Unless Otherwise Indicated to be: White with Thermos-plastic Nylon wall plate.
    3. Wiring Devices Installed in Finished Spaces to be: White with Thermos-plastic Nylon wall plate.
    4. Wiring Devices Installed in Exterior areas to be: White with while in use weatherproof cover plates.
        1. Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
    5. Wiring Devices Installed in Wet or Damp Locations: Include weatherproof covers.
        1. All receptacles in wet locations to include while in-use covers.

2.02 WALL SWITCHES

1. Switches to: CSA C22.2 No.111 and CSA C22.2 No.55.
2. Standard Wall Switches:
    1. Specification Grade, Decora rocker type type.
    2. 15A, 120/277V, single pole, three-way, and four-way.
    3. Screw terminals approved for No. 10 AWG wire.
    4. Fully rated for lighting loads, specific to lighting load type, and up to 80% of rated capacity of motor loads and heating loads.
    5. Switches of one manufacturer throughout project.

3. Wall Dimmers:
    1. In addition to the Standard wall switch requirements:
        1. To suit lighting load type (incandescent, fluorescent, CFL, LED), Wattage, and dimming method.

2.03 RECEPTACLES

1. Specification Grade, Decora rocker type
2. Duplex receptacles, CSA types 5-15R and 5-20R , 125 V, U ground, to: CSA C22.2 No.42 with following features:
    1. Screw terminals approved for No. 10 AWG wire.
    2. Break-off links for use as split receptacles.
    3. Eight back wired entrances, four side wiring screws.
    4. Triple wipe contacts and rivitted grounding contacts.
    5. Ground fault and arc fault protected type were indicated or mandated by code.
3. Single receptacles CSA type as shown on the drawings with the following features:
    1. Screw terminals approved for wiring ampacity in excess of receptacle rating to allow for increased conductor size and reduced voltage drop.
    2. Suitable for No. 10 AWG for back and side wiring.
4. Arc fault protected in accordance with code requirements. Refer to panel schedule for proposed arc fault breakers.
5. Receptacles of one manufacturer throughout project.
6. Special wiring devices:
    1. Future EV charging station rough-in. Refer to drawings for details.
7. Manufacturer Standard of acceptance
    1. Leviton, Pass & Seymour, or Hubbell.

2.04 PARKING RECEPTACLE

1. Intelligent regulated parking outlet based on exterior temperature.
2. Zinc die-cast
3. Indicating LED lights
4. 15A split type.
5. Weather resistant gasket.
6. IPLC M210 Series or approved equivalent.

2.05 HEAT TRACE

1. Arctic Vent
    1. Heat trace specification by mechanical.
    2. 120V, 75W
    3. Coordinate with mechanical division for final connection locaiton, type and heating cable product used.
        1. Allow for ground fault receptacle or ground fault breaker.

2.06 LEAK DETECTION

1. Provide leak detection device in the crawlspace. Sensor location to be coordinated with low point/sump pit in crawlspace as noted on the architectural plans.
2. 120V or 24V connection.
3. Audible alarm when WiFi Connectivity cannot be achieved.

4. WiFi connectivity with email, app notifications to phones.
5. Standard of acceptance: Govee WiFi Water Sensor system or approved equivalent.

EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

1. General:
    1. Mount devices at heights in accordance with Section 26 05 00- Common Work Results for Electrical or as indicated in the construction documents. Final heights to be reviewed with other applicable division's design documents prior to rough-in.
    2. Reverse wiring connection direct to devices is not acceptable.
    3. Install wiring devices in accordance with manufacturer's instructions.
    4. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
    5. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
    6. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
    7. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
    8. Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
2. Switches:
    1. Install single throw switches with handle in "UP" position when switch closed.
    2. Install switches in gang type outlet box when more than one switch is required in one location.
    3. Mount switches at height in accordance with Section 26 05 00- Common Work Results for Electrical or as indicated in the construction documents Final heights to be confirmed with other applicable division's design documents prior to rough-in.
3. Receptacles:
    1. Install receptacles in gang type outlet box when more than one receptacle is required in one location.
    2. Where split receptacle has one portion switched, mount vertically and switch upper portion.
    3. Install GFI type receptacles as indicated and as required by code. Provide weather-proof covers on all wet location devices.
4. Wall plates:
    1. Install suitable common cover plates where wiring devices are grouped.
    2. Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
    3. Weatherproof covers:

1. Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

5. Block Heater Parking Post
    1. Anchored and mounted to concrete foundation. Coordinate with Architect and Civil for final location and base requirements.

END OF SECTION

PART 1 GENERAL

1.01 PHOTO VOLTAIC SYSTEM REQUIREMENTS - DESCRIPTION

1. System Description:
    1. Provide solar systems necessary for connection to existing facility electrical systems;
        1. Coordinate details with noted requirements.
    2. Photovoltaic array is roof-mounted.
    3. The proposed orientation of the array is as indicated on Drawings. The contractor is required to confirm layouts as required to achieve generation targets outlined.
    4. System is to include interconnection with utility grid (grid-tied system);
    5. System does is not to include battery storage
    6. System to include DC surge protection.
    7. The contractor will facilitate the process for available federal, provincial, and other rebate incentive programs currently available.

1.02 CAPACITY:

1. Minimum Expected Annual Energy as calculated by HelioScope PV design software or equivalent.
    1. Average annual Production : 4,522kWh
        1. The contractor is responsible to size the PV array such that the Average Annual Production meets or exceeds the kWh noted above.
    2. Approximate Lifetime Production (25 years): 106,523kWh
        1. The contractor is to provide products that are project and are suitable to generate power for minimum 25 years.
2. Array
    1. Designed to fit within area designated on Drawings.
        1. Locations shown are diagrammatic. The contractor is responsible for final layouts and design to adhere to the performance requirements of the system.
    2. Arrange array such that normal roof drainage is not affected.
    3. Arrange array to maintain required safety clearances from edges of roof as required by authority having jurisdiction.
    4. Arrange array to maintain access and clearance requirements for other roof- mounted equipment and any hazardous locations.
    5. Arrange array to minimize shading during peak production periods.
    6. Arrange array to provide adequate access to rear of string(s) for maintenance.
    7. Arrange array to avoid spanning of expansion joints.

1.03 GENERAL REQUIREMENTS:

1. Appearance:
    1. Arrange array such that modules are aligned with uniform spacing.
    2. Make no alterations affecting appearance of building exterior or interior without approval of Consultant.
    3. Cable and conduit routing to be neat and tidy.
    4. Final determination of acceptable appearance is by Consultant.
2. The system is not to export any power to the grid. Provide smart meter with required CT's and PT's to ensure zero export.
    1. Complete all utility coordination including but not limited to application and design forms.

3. The system is to include rapid shutdown as per the CAnadian electrical code 64-218.
4. Fire Resistance Rating: Provide photovoltaic module and mounting system combination that together with roof covering form system listed in accordance with CSA C22.2 No. 107.1 to provide fire resistance rating equal to or better than required fire rating of roof.
5. Provide photovoltaic system and associated components suitable for wind loads, snow loads, seismic loads, and other structural design considerations of installed location.
6. Include structural calculations demonstrating compliance with submittals.
7. Provide photovoltaic system and associated components suitable for continuous operation under service conditions at installed location.
    1. Altitude: ~55m
    2. Ambient Temperature between 32°C and -57°C.
    3. Azimuth: 198° (S)
    4. Roof Slope: ~14°
8. Provide products listed, classified, and labeled as suitable for purpose intended.
9. Unless specifically indicated to be excluded, provide required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for complete operating system.
10. DC Arc Fault Circuit Protection: Provide DC photovoltaic arc-fault protection devices listed as complying with UL 1699B as required for compliance with CSA C22.1.
11. Rapid Shutdown of Photovoltaic Systems on Buildings: Provide listed equipment arranged to provide rapid shutdown in accordance with CSA C22.1.
12. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and CSA C22.1.
13. All Metal parts including but not limited to racking and panel frames are to be grounded.
14. The appearance of the PV panels should be homogeneous gray.
    1. The PV panels should be grade A : new, without scratch or geometric discrepancy.
15. Note that specified products are for reference and do not negate the responsiblity of the solar contractor to adhere to performance and other requirements noted in these specifications. Complete all required modelling and provide products to suit.

PART 2 PRODUCTS

2.01 PHOTOVOLTAICS - BALANCE OF SYSTEM COMPONENTS

1. PV Panels
    1. 8 Modules per unit are shown. Contractor to confirm final details of strings required for capacity output.
    2. Product standard of acceptance:
    3. Longi Solar LR4-72HPH-435M or demonstrated approved equivalent.
2. Photovoltaic Module Mounting System:
    1. Provide complete mounting system compatible with modules to be installed and suitable to properly install them in location indicated, including necessary hardware and accessories.
    2. Support Structure and Associated Hardware Materials: Use aluminum, galvanized or stainless.
    3. Roof-Mounted Arrays:
        1. Provide system compatible with roof at installed location.
        2. Module tilt angle as required to provide maximum energy production for installed location.

3. Photovoltaic Combiner Boxes:
    1. Provide combiner box(es) for termination of strings as required for array configuration installed.
    2. PV Metering to ensure zero export to the grid.
    3. Suitable for export limitation and consumption monitoring.
    4. NEMA 3R enclosure.
    5. RS485 communications between inverter and meter.
    6. 120V powered unit.
    7. CT's and PT's on the main service entrance junction box.
        1. Current transformers compatible with device. Standard of acceptance:
        2. SEACT07580-200NA-20
        3. Meter standard or acceptance:
            1. Solar Edge SE-MTR240-NN-S-S1 or approved equivalent.
4. Photovoltaic Inverters:
    1. Provide inverter(s) as indicated or as required for connection of photovoltaic array DC system to AC system indicated.
    2. Inverters: Suitable for requirements of connected array; output configuration compatible with connected system; listed as complying with UL 1741 and CSA C22.2 No. 107.1; furnished with the following features:
        1. Maximum power point tracking (MPPT).
        2. Integral AC disconnect.
        3. Integral DC disconnect.
        4. Integral DC ground fault detection and interruption.
        5. Communications Interface: to allow remote monitoring of the system.
        6. Tthe inverter is to include an insulation default detection between +|PE, -|PE and -|+
        7. Inverter standard or acceptance:
            1. Fronius Primo 3.8 (240V) or approved equivalent.
5. Factory test the solar products to verify operation and performance characteristics:
    1. Photovoltaic modules.
    2. Photovoltaic inverters.
6. Warranty
    1. 25-year linear power production warranty
    2. 10-year inverter warranty

PART 3 EXECUTION

3.01 PV EXAMINATION, PREPARATION AND INSTALLATION

1. Verify that site measurements are as indicated.
2. Verify that ratings and configurations of system components are consistent with indicated requirements.
3. Verify that mounting surfaces are ready to receive system components. Suitable clips for coupling with roof system.
4. Verify that conditions are satisfactory for installation prior to starting work.
5. Use open circuiting, short circuiting, or opaque covering to disable modules, array or portions of array prior to installation and service.
6. Roof-Mounted Arrays: Protect roof and adjacent roof-mounted items from damage.

7. Install products in accordance with manufacturer's instructions.
8. Install photovoltaic system in accordance with CSA C22.1.

3.02 REQUIREMENTS FOR REVIEW OF THE WORK

1. Contractor shall contact the Consultant for a minimum of rough-in and final reviews. Additional reviews will be completed as required; contractor is to make Consultant aware regarding any conditions that warrant special reviews.
2. Contractor shall ensure that all required work is completed prior to calling for review. Additional charges may be levied should additional reviews be required due to lack of completion of work to be reviewed.
3. A set of full-size site drawings and specifications are to be kept up to date and on site at all times. All changes and instructions that affect the construction documents are to be modified with red pen. Include PDF and working form record drawings.
4. At the completion of the project, record drawings are to be completed in the same software that the original plans were created (typically AutoCAD or Revit).

3.03 SYSTEM STARTUP

1. Include manufacturer's detailed startup procedures with submittals.
2. Obtain Owner's approval prior to performing system startup.
3. Full review of installation by consultant.
4. Ensure all labelling of AC and DC systems are added prior to completion.
5. Typical Testing:
    1. Review array for unstrapped PV cables
    2. Verify PV voltage of each string from modules.
    3. Verify PV voltage of each PV panel.
    4. Engerize Inverter. Complete grid timer test sequences
    5. Clamp on each PV string with DC clamp on meter and record amperage
    6. Once inverter is showing production testrapid shutdown and confirm that inverter PV voltage is under 30VDC with 30s of rapid shutdown.
    7. Reset the rapid shutdown button and confirm the inverter is producing power.
    8. Complete manufactuer recommended testing.
    9. Additional testing as outlined by the engineer during commissioning.
    10. Record all results of testing and submit to engineer.

END OF SECTION

GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

1. Provide submittals in accordance with Section 26 05 00 - Electrical Common Work Results and as noted below.
2. Provide the required number of submittals promptly and deliver through appropriate channels, leaving sufficient time for adequate review and possible resubmittals without affecting Construction Schedule.
3. Verify actual field dimensions, and quantities.
4. No release of orders for lighting equipment shall be made until review of submittals is complete.
5. Submit shop drawings for all products as follows:
    1. Provide complete, fully dimensioned detail Drawings including all major components and details of fabrication.
    2. Provide requisite schematics and plans indicating assembly and installation of components.
    3. Provide inventory of all equipment to be supplied including types, quantities, and reference to applicable Drawings and schematics.
    4. Submit a list of luminaire types and quantities and catalogue cuts for all product data including lamps, ballasts and or drivers. Such data shall show both technical and pictorial detail, marked specifically to show the optional or alternate components required, the exact catalogue number, and type designation corresponding to the type indicated in the Luminaire Schedule. Include this data also with Installation, Operation and Maintenance Manuals with the Consultant's review stamp. Provide the number of copies required by Owner plus three additional. Manufacturer's product data shall be marked clearly to indicate all technical information that indicates conformance to all specified requirements in Contract Documents.
6. Equivalents:
    1. Equivalents shall be submitted complete with cover sheet, index, completed cutsheets, sketches, shop drawings and any other supporting documentation required to demonstrate compliance with the specification. The submittal shall demonstrate compliance to any specific performance, and, clearly note, *met / not met* for: driver performance, LED performance, luminaire performance, light quality, and finish treatments as required in Part 1 and 2 of this Section. In addition, provide COI calculation and UGR rating where specified. Continuous run fixtures shall provide shop drawing example of continuous run and cross section connections.
    2. Clearly highlight and comment all deficiencies.
    3. For gasketed fixtures that are not IP65, include shop drawing section showing lens gasket solution and ceiling/flange gasket specification.
7. Product Data:
    1. Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval by Consultant.

1.02 DELIVERY, STORAGE AND HANDLING

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

PRODUCTS

2.01 GENERAL

1. Provide all products with CSA labels or appropriate approvals (i.e. cUL, cETL) for all mounting conditions.
2. Provide luminaires new and complete with mounting accessories, junction boxes, trims, and lamps.
3. All products of the same specified type are to be of the same manufacturer.
4. The luminaire types group shall be by one manufacturer:
5. Luminaire type catalogue numbers do not necessarily denote required mounting equipment or accessories. Provide all appropriate mounting accessories for all mounting conditions.
6. Provide appropriate accessories for proper mounting of all luminaires. For example, include plaster frames for plaster ceiling. For luminaires in rated ceiling, provide firestop protection as specified elsewhere. For luminaires suspended from ceiling, provide pendants or aircraft cables complete with accessories to complete the installation as indicated on the Drawings.
7. If the words “or approved equivalent” are not indicated after any luminaire manufacturer and catalog number in the fixture schedule, then no other manufacturer oe luminaire will be acceptable for that particular type.

2.02 LAMPS

1. All luminaires shall be provided with proper, new, and operable lamps. Provide lamps indicated on the luminaire schedule, or, if not indicated, as recommended by the luminaire manufacturer. Lamps shall be compatible with the respective fixtures.

2.03 LED LUMINAIRES

1. LED life expectancy shall be minimum 115,000 hours at 70% lumen maintenance (L70) as determined by IES test standard LM-80 and TM-21.
2. Interior LED luminaires shall be no less than CRI 80, and specified colour temperature tolerance within a maximum 3-step McAdam ellipse as determined by IES test standard LM-79. A maximum 3-step McAdam ellipse colour range must not be exceeded throughout the entire dimming range. The minimum Ra R9 chromaticity value shall be as follows:
    1. 80+ CRI, no less than 14;
    2. 90+ CRI, more than 60;
    3. 94+ CRI, more than 90;
    4. Or greater as specified.
3. Exterior LED luminaires shall be CRI 80 or more and specified colour temperature tolerance within a maximum 3-step McAdam ellipse as determined by IES test standard LM-79. The minimum Ra R9 chromaticity value shall be as follows:
    1. 80+ CRI, >0.

2.04 DRIVERS AND POWER SUPPLIES

1. LED drivers
    1. LED source driver operation frequency shall be in excess of 660 hertz.
    2. High efficiency LED electronic drivers, integral or remote, with minimum 50,000-hours rating shall be used.
    3. Pulse width modulation dimming is not allowed. Only constant current reduction dimming will be allowed.
    4. LED lamp/driver and dimmer combinations must be tested and approved by the manufacturer.

2.05 REMOTE DRIVERS AND POWER SUPPLIES

1. Remote driver box assemblies shall be equal to Western Lighting No. WL7679, 20-gauge painted steel boxes with knock-outs and louvred covers mounted on end tracks of minimum 16-gauge painted steel.
2. Remote drivers shall have properly sized igniters to ensure starting at distances indicated on the Drawings.
3. Locate remote drivers in accessible locations. Remote drivers shall not be located in occupied rooms.
4. Remote low-voltage transformers
    1. All remote low voltage transformers shall have replaceable fuses.
    2. All outdoor transformers shall be properly ventilated and mounted in approved weatherproof enclosure.
    3. Locate remote transformers in accessible locations. Remote transformers shall not be located in occupied rooms.

2.06 LUMINAIRE CONSTRUCTION

1. General
    1. All luminaires shall be free of light leaks.
    2. Luminaires in non-accessible ceilings shall have accessible junction boxes, ballasts, and transformers through luminaire apertures.
    3. No metal clips, screws or angles shall be visible when the luminaire is viewed from below.
2. Tamper resistant and vandal resistant construction:
    1. Tamper resistant type luminaire: Minimum 16-gauge housing, high impact resistant clear polycarbonate lenses, tamper-proof hardware and ligature proof when wall or surface mounted fixture applies.
    2. Tamper-type luminaires: Two-part optical acrylic upper lens and impact resistant polycarbonate lower lens and assembly. Polycarbonate lens shall be a 6mm (0.236”) clear solid polycarbonate impact lens; polycarbonate shall be tested to ASTM or equivalent standard, be UV treated and with minimum 82% light transmission, yellowness index <1 and haze of <0.5%. Lens assembly shall be sealed, and accessible with SS Torx (or similar) security hardware, hex type fasteners shall not be accepted. Luminaire shall be light leak- free with no hot spots and no visible point source. IP65.

2.07 LUMINAIRE FINISHES

1. Painted luminaires shall have synthetic enamel, with acrylic, alkyd, epoxy, polyester or polyurethane base applied after the luminaire is completely constructed. Paint shall be light stabilized, baked on at minimum 180ºC, and catalytically or photochemically polymerized after application.
2. All metal parts shall be cleaned and treated with phosphate or chromate bonding process after fabrication for maximum paint adhesion.
3. All polished decorative metals shall have a clear protective finish, baked-on lacquer or air-cured urethane.
4. Anti-microbial finishes for medical / hospital use shall be applied where required in addition to luminaires’ regular finishes and or protective coatings.

2.08 EXTERIOR LIGHTING

1. Supply and install exterior lighting as indicated in the luminaire schedule and as shown on the Drawings complete with poles, arms, luminaires, lamps, anchor bolts and setting template, nut covers, handholes and covers and other accessories necessary for proper installation.

EXECUTION

3.01 VERIFICATION OF CONDITIONS

1. Confirm all ceiling depths against final architectural ceiling plans and sections to ensure that recessed luminaires can be installed in all ceiling conditions and advise the Consultant immediately of any discrepancies prior to ordering of the fixtures or proceeding with the Work.

3.02 INSTALLATION - GENERAL

1. Luminaires shall be installed as indicated on the Drawings and per approved shop drawings. Notify Consultant of any variance or conflict between the Drawings and Site conditions. Do not proceed until conflict has been resolved.
2. Luminaires are indicated in the luminaire schedule by means of type letters which correspond to similar letters on the plans.
3. Luminaires shall be installed in accordance with luminaire manufacturer's written instructions, applicable requirements of CEC, applicable authorities, and with recognized industry practices.
4. All luminaires shall be supported from the building structure or from bridging attached to the structure. Provide all necessary hardware and blocking to ensure that luminaires hang true, square, plumb, and in proper alignment.
5. Luminaires shall be adequately supported and braced to seismic engineer's approval.
6. Provide every light outlet in the construction documents with a luminaire as instructed, complete with lamps and other accessories necessary for its proper installation and operation. If a luminaire type is not designated for any particular outlet, obtain the necessary details from the Consultant. Provide a luminaire for the outlet as directed by the Consultant.
7. Effectively ground all luminaires. Luminaires with their sockets so far apart as to give less than perfect contact at the lamps, or with poor grounds, will be rejected and shall be replaced without charge.
8. Install luminaires true to the surface in or to which they are mounted, and except where otherwise indicated on the Drawings, align with the building or the room walls. Where no elevation is shown, confirm mounting height with the Consultant prior to rough-in.
9. Where luminaires are stem hung from 'ball and socket' swivels at the ceiling, use stranded wire, #16 AWG (19x 29) minimum size, from outlet box to the fixture.
10. .Where luminaires are chain-suspended, use solid conductor in armoured cable or flexible conduit and secure to chain with white or clear nylon cable ties, as specified elsewhere.

3.03 FIELD QUALITY CONTROL

1. Operate each luminaire after installation and connection. Each luminaire shall be inspected for proper connection and operation.
2. Perform testing of operation of temporary or emergency power systems.
3. Verify that all lenses, louvres, baffles, luminaire trim cones, diffusers and other parts are thoroughly cleaned in a manner recommended by the manufacturer.
4. Replace all lamps used during construction with new lamps prior to final acceptance of the Project.

3.04 ADJUSTMENT

1. All adjustable luminaires shall be aimed by the contractor in coordination with the owner. Final review and adjustment to be as instructed by the Consultant. Personnel, lifts, and ladders shall be provided as required.
2. Adjust suspension heights for linear luminaires as instructed by the Consultant.

END OF SECTION

GENERAL

1.01 REFERENCE STANDARDS

1. CSA Group (CSA)
2. Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
    1. TIA/EIA-570-D , Residential Telecommunications Cabling Standard, Part 1: General Requirements.
    2. TIA TSB-140, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.

PRODUCTS

2.01 FOUR-PAIR 100 W BALANCED TWISTED PAIR CABLE

1. Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT4 or MPG or CMG to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA standards .

2.02 UP TO 4-PAIR MODULAR RJ45 JACKS

1. Up to four-position modular jack ("RJ-45"), type T568A Category 6 to: TIA/EIA-568-B.2 :
    1. Ganged with existing similar boxes as required. Vapor barier as required.
2. Multi-user telecommunications outlet assembly (MUTOA), installed "RJ-45" jacks, type field to: TIA/EIA-568-T568A Category 6 cable.
3. Provide suitably patch panel component in with the telecom media panel for termination of RJ45 cables.

2.03 COAXIAL CABLE AND SPLITTERS

1. All cables to NWTel standards.
    1. 75 ohm RG6 coaxial cables for device wiring back to the telecom backboard. White in color. FT-1 Rated minimum.
    2. Provide 3 meters of slack cable in the media panel for all field coaxial device wiring back to the media panel. Allow for coaxial termination of RG6 cables at the media panel in coordination with telecom authority.
    3. Provide cover plante and terminate coaxial cables at location of device.
    4. Provide vapor barrier

EXECUTION

3.01 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

1. Install horizontal cables as indicated in free air with conforming staples from telecommunication rooms to individual area jacks . Identify and label as indicated to: TIA/EIA standards .

3.02 FIELD QUALITY CONTROL

1. Test horizontal UTP cables as specified below and correct deficiencies provide record of results.
    1. Perform tests for Permanent Link on installed cables, including spares:
        1. Category 6 using certified level III tester to: TIA/EIA standards .
        2. RG6 cables.
2. Provide record of results as hard copy and electronic record.

END OF SECTION

1.1 RELATED REQUIREMENTS

.1 Section 32 11 23 Aggregate Base Course

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM D698-07, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).

.2 ASTM D2922, Standard Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Co-ordination: arrange with authority having jurisdiction for relocation of buried services that interfere with execution of work.

.1 Pay costs of relocating services.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Notify Departmental Representative of proposed source for embankment fill a minimum of 2 weeks before construction to allow for review and acceptance.

.1 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.

.2 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Storage and Handling Requirements:

.1 Replace defective or damaged materials with new.

.2 Protect materials from contamination.

.3 Stockpile materials to prevent segregation.

.4 Stockpile materials in areas approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Granular base course to Section 32 11 23 Aggregate Base Course

.2 Acceptable embankment material:

.1 Locally available, clean natural gravel material, free from silt, clay, loam, friable or soluble materials and organic matter.

.2 Maximum gravel particle size to be 150 mm.

.3 Embankment material intended for rough grading and infill around the building, and temporary access purposes.

.1 Refer to Structural Drawings for granular foundation under building.

.4 All materials shall be free of ice and snow.

Part 3 Execution

3.1 EXAMINATION

.1 Evaluation and Assessment:

.1 Examine Desktop Geotechnical Evaluation appended.

.2 Before commencing work establish locations of buried services on and adjacent to site.

3.2 PREPARATION

.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees, and other plants, lawns, fencing, service poles, wires, utilities, culverts, signs, roadways, survey benchmarks and monuments that may be affected by Work.

.2 Protection of in-place conditions:

.1 Protect excavations from freezing.

.2 Keep excavations clean, free of standing water, and loose soil.

.3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.4 Protect buried and above ground services that are required to remain undisturbed.

.3 Removal:

.1 Remove brush, shrubs, bushes, undergrowth, rotten wood, dead plant material, exposed boulders and debris within the project site.

.2 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

3.3 SOIL STRIPPING

.1 Remove topsoil, vegetation, rocks, and before construction procedures commence.

.2 Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation by composting.

.3 Remove brush from targeted area by non-chemical means and dispose of through mulching.

.4 Strip topsoil to depths as directed by Departmental Representative.

.1 Avoid mixing topsoil with subsoil.

.5 Contractor to dispose of unused or unacceptable stripping materials.

3.4 FIELD QUALITY CONTROL

.1 Contractor to retain and pay for third party material testing agency to carry out testing of materials and compaction of fill.

.2 Do not begin backfilling or filling operations until material has been approved for use by Departmental Representative.

.3 Not later than 72 hours before backfilling or filling with approved material, notify Departmental Representative to witness compaction tests carried out by retained testing agency.

3.5 EMBANKMENT

.1 Areas to be filled to embankment to be free from debris, snow, ice, water and frozen ground.

.2 Do not use material which is frozen or contains ice, snow or debris.

.3 Place embankment material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.4 Compact each layer to a minimum 98% maximum dry density to ASTM D698.

.5 Shape and roll alternatively to obtain a smooth, even and uniformly compacted subgrades surface.

.6 Apply water as necessary during compaction to obtain specified density.

.7 If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is correct to value not greater than 1.0% moisture above optimum value for compaction ASTM D698.

.8 The frequency of field density testing, and moisture content tests shall be a minimum of one test per 100 square meters per lift thickness place.

.9 If a density test indicates insufficient compaction, then the area must be recompacted, and two additional compaction tests shall be performed in the same general area to confirm the compaction specification has been met.

3.6 PROOF ROLLING

.1 For proof rolling use standard tandem axle truck fully loaded with soil.

.2 Obtain written approval from Departmental Representative to use nonstandard proof rolling equipment.

.3 Proof roll at level in subgrade as indicated.

.1 If use of nonstandard proof rolling equipment is approved Departmental Representative to determine level of proof rolling.

.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

.5 Where proof rolling reveals areas of defective subgrade:

.1 Remove subgrade material to depth and extent as directed by Departmental Representative.

.2 Replace with new materials in accordance with this section at no extra cost.

3.7 GRADING

.1 Maintain profiles, crowns, and cross slopes to provide good surface drainage.

.2 Grade so that water will drain away from buildings, walls and gravelled areas to drainage runs and other disposal areas approved by Departmental Representative.

.1 Grade to be gradual between finished spot elevations shown on drawings.

.3 Finish slopes and ditch bottoms to neat condition, true to lines, grades and drawings where applicable.

.4 Scarify subgrade to full width as directed by the Engineer and to depth of 150 mm minimum.

.5 Pulverize and break down scarified material to 50 mm maximum soil clod size.

.6 Reshaped compacted surface to be within plus or minus 10 mm of elevation as indicated.

.7 Hand finish slopes that cannot be finished satisfactorily by machine.

.8 Obtain the Engineer’s approval of ditches and site grading prior to replacing topsoil or base course.

.9 Shortage and Surplus:

.1 Supply all necessary fill to meet embankment and grading requirements and with minimum and maximum rough grade variance.

.2 Dispose of surplus material off site.

3.8 PLACING OF TOPSOIL

.1 Place topsoil or stripped soils only after Departmental Representative has accepted subgrade.

.2 Spread topsoil or stripped soils during dry conditions in uniform layers not exceeding 100 mm over unfrozen subgrade free of standing water.

.3 Establish traffic patterns for equipment to prevent driving on topsoil or stripped soils after it has been spread to avoid compaction.

.4 Cultivate soil to a 25 mm depth.

3.9 RESTORATION

.1 Upon completion of work, haul excess materials off-site, remove waste materials and debris, trim slopes and correct defects as directed by the Engineer

.2 Reinstate fences, gravelled surfaces, decorative rock, driveways and lawns to condition which existed before construction.

.3 Clean and reinstate areas affected by work as directed by the Engineer.

3.10 CLEANING

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

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

.2 Dispose of cleared and grubbed material off site daily.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 1 74 11- Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 31 00 00.01 Earthworks – Short Form

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM D698-07, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Notify Departmental Representative of proposed source of granular base course a minimum of 2 weeks before construction to allow for review and acceptance.

.1 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.

.2 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Storage and Handling Requirements:

.1 Replace defective or damaged materials with new.

.2 Protect materials from contamination.

.3 Stockpile materials to prevent segregation.

.4 Stockpile materials in areas approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Granular base acceptable material:

.1 Locally available, clean natural gravel material or crushed stone, free from silt, clay, loam, friable or soluble materials and organic matter.

.2 Maximum gravel particle size to be 20 mm.

.3 Granular base material intended for driving surfaces.

.4 All materials shall be free of ice and snow.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for granular base installation.

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PLACEMENT AND INSTALLATION

.1 Place granular base after subgrade surface is inspected and approved in writing by Departmental Representative.

.2 Placing:

- .1 Construct granular base to depth and grade in areas indicated.
- .2 Ensure no frozen material is placed.
- .3 Place material only on clean unfrozen surface, free from snow and ice.
- .4 Place material using methods which do not lead to segregation or degradation of aggregate.
- .5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
  - .1 Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .7 Remove and replace that portion of layer in which material becomes segregated during spreading.

.3 Compaction Equipment:

- .1 Ensure compaction equipment is capable of obtaining required material densities.

.4 Compacting:

- .1 Compact to density not less than 98 % corrected maximum dry density to ASTM D698.
- .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .3 Apply water as necessary during compacting to obtain specified density.
- .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by Departmental Representative.
- .5 The frequency of field density testing, and moisture content tests shall be a minimum of one test per 100 square meters per lift thickness place.

.6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

.5 Proof rolling:

.1 For proof rolling use standard tandem axle truck fully loaded with soil.

.2 Obtain written approval from Departmental Representative to use nonstandard proof rolling equipment.

.3 Proof roll at level in granular base as indicated.

.1 If use of nonstandard proof rolling equipment is approved Departmental Representative to determine level of proof rolling.

.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

.5 Where proof rolling reveals areas of defective granular base course:

.1 Remove granular base and subgrade material to depth and extent as directed by Departmental Representative.

.2 Replace with new materials in accordance with this section at no extra cost.

3.3 FIELD QUALITY CONTROL

.1 Field Quality Control in accordance with Section 31 00 00.01 – Earthworks – Short Form.

3.4 SITE TOLERANCES

.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

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-.

3.6 PROTECTION

.1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

GENERAL

1.01 QUALITY ASSURANCE

1. Regulatory Requirements:
    1. Ensure Work is performed in compliance with applicable Provincial/Territorial regulations.
    2. Co-ordinate and meet requirements of power supply authority.
        1. Ensure availability of power when required.

1.02 DELIVERY, STORAGE AND HANDLING

1. Packing, shipping, handling and unloading:
    1. Deliver, store and handle materials in accordance with manufacturer's written instructions.
2. Storage and Protection:
    1. Store materials in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

PRODUCTS

2.01 MATERIAL

1. All installations to the approval of the supply authority and authority having jurisdiction.
2. Service mast: rigid heavy duty, galvanized steel, suitable for attachment of support clamps, insulator rack, weatherhead, service drop fittings.
3. Weatherhead: to approval of supply authority .
4. Rigid steel galvanized conduit, fittings: in accordance with Section 26 05 34- Conduits, Conduit Fastenings and Conduit Fittings .

EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

1. Install service mast (rigid steel conduit) and weatherhead.
2. Install metre socket and conduit.
3. Install service drop conductors allowing sufficient conductor length for connection to service equipment.
4. Allow sufficient conductor length for connection to supply by power supply authority.
5. Allow sufficient conductor length for drip loops.

END OF SECTION