

Your **Trusted Choice** for Mechanical & Electrical Consulting Engineers



2123 Rte. 500 W. Embrun, ON
Cambridge Public School
Addition Architectural Services
UCDSB RFQ #25-036

MECHANICAL SPECIFICATION
ISSUED FOR TENDER



GWAL 2025-385

February 10, 2026

Reviewed By:

Petar Azdajic, B.Eng. | Intermediate Mechanical Designer

Reviewed By:

Steve Hamilton, P.Eng. | Director, Mechanical Engineer

<u>SECTION</u>	<u>TITLE</u>	<u>PAGES</u>
DIVISION 20 - COMMON REQUIREMENTS FOR MECHANICAL		
20 05 01	MECHANICAL GENERAL REQUIREMENTS	14
20 05 49.01	SEISMIC RESTRAINT SYSTEMS (SRS) FOR MECHANICAL SYSTEMS	4
20 31 00	ACCESS DOORS FOR MECHANICAL SYSTEMS	1
DIVISION 21 - FIRE SUPPRESSION		
21 13 13	WET PIPE FIRE SUPPRESSION SPRINKLERS	6
21 24 00	PORTABLE FIRE EXTINGUISHERS	2
DIVISION 22 - PLUMBING		
22 10 10	PLUMBING PUMPS	2
22 11 16	DOMESTIC WATER PIPING – COPPER & STAINLESS STEEL	5
22 13 18	DRAINAGE WASTE & VENT PIPING - PLASTIC	3
22 30 05.01	DOMESTIC WATER HEATERS	3
22 42 01	PLUMBING SPECIALTIES AND ACCESSORIES	8
22 42 03	PLUMBING FIXTURES AND TRIM	3
DIVISION 23 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC)		
23 01 31	CLEANING OF COMMERCIAL HEATING, VENTILATING AND AIR CONDITIONING	6
23 05 05	INSTALLATION OF PIPEWORK	3
23 05 16	FLEXIBLE CONNECTIONS EXPANSION JOINTS, ANCHORS AND GUIDES	4
23 05 19	THERMOMETERS AND PRESSURE GAUGES	2
23 05 23	VALVES	4
23 05 29	BASES, HANGERS, AND SUPPORTS	5
23 05 53	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT	4
23 05 93	TESTING, ADJUSTING AND BALANCING (TAB) OF MECHANICAL SYSTEMS	6
23 07 13	THERMAL INSULATION FOR DUCTING	4
23 07 15	THERMAL INSULATION FOR PIPING	5
23 08 01	PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEMS	2
23 08 02	CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS	3
23 11 23	PIPING, VALVES & FITTINGS - GAS	4
23 21 13.02	HYDRONIC SYSTEMS: STEEL	3
23 21 14	HYDRONIC SPECIALTIES	4
23 21 23	PUMPS - HYDRONIC SYSTEMS	5
23 31 13.01	DUCTWORK - LOW PRESSURE - METALLIC TO 500 PA	4
23 33 00	DUCT ACCESSORIES	2

23 33 14 DAMPERS - BALANCING	1
23 33 53 ACOUSTIC DUCT LINING	2
23 37 13 GRILLES, REGISTERS, & DIFFUSERS	2
23 52 00.10 PACKAGED BOILERS - CONDENSING (VIESSMAN)	3
23 74 00 PACKAGED OUTDOOR HVAC EQUIPMENT	6
23 82 39 HYDRONIC FORCE FLOW UNITS	3

DIVISION 25 - INTEGRATED AUTOMATION

25 01 11 EMCS: START-UP, VERIFICATION AND COMMISSIONING	5
25 01 12 EMCS: TRAINING	2
25 05 01 EMCS: GENERAL REQUIREMENTS	5
25 05 02 EMCS: SUBMITTALS AND REVIEW PROCESS	3
25 05 03 EMCS: PROJECT RECORD DOCUMENTS	2
25 05 54 EMCS: IDENTIFICATION	2
25 05 60 EMCS: FIELD INSTALLATION	6
25 08 20 EMCS: WARRANTY AND MAINTENANCE	3
25 10 01 EMCS: LOCAL AREA NETWORK (LAN)	2
25 30 02 EMCS: FIELD CONTROL DEVICES	5
25 90 01 EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION	4

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with all mechanical sections, and all other disciplines related to the project.

1.2 GENERAL

- .1 All references to OBC/NBC shall be to the version in effect as at the time of the permit application.
- .2 All references to codes/standards/etc. throughout the specification shall be to the version referenced by OBC/NBC (whichever is applicable) as at the time of the permit application. References to codes/standards/etc. that are not referenced by OBC/NBC shall be to the latest version as at the time of tender.

1.3 REFERENCES

- .1 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1 , Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Ontario Regulation
 - .1 ONTARIO OBC, Ontario Building Code Compendium.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 13 , Installation of Sprinkler Systems.
- .4 National Research Council Canada
 - .1 NRCC NBCC, National Building of Canada.

1.4 EQUIPMENT

- .1 General:
 - .1 Mechanical equipment that is not regulated by the Green Energy Act, shall carry a permanent label installed by the manufacturers stating the equipment complies with the requirement of ASHRAE 90.1.
 - .2 The minimum equipment efficiency, standard rating and operating conditions shall be as per ASHRAE 90.1, superseded by Ontario Building Code (OBC) Supplementary Standard SB -10, unless indicated otherwise on contract documents. The higher of the energy efficiencies of the listed equipment shall prevail.
 - .3 Provide new materials and equipment of proven design, quality and of current models with published ratings for which replacement parts are readily available.
 - .4 Uniformity: Use product of one manufacturer unless otherwise specified, for equipment or material of the same type of classification.
- .2 Installation:
 - .1 Unions, flanges and/or couplings: provide for ease of maintenance and disassembly.
 - .2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer, Code or as indicated; whichever is the more stringent.
 - .3 Equipment drains pipe to floor drains in a manner which is non-obstructing.

- .4 Install equipment, rectangular cleanouts, and similar items parallel to or perpendicular to building lines.
- .5 Unless otherwise specified, follow manufacturer's recommendations for safety, adequate access for inspection, maintenance, and repairs.
- .6 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems without interference with building structure or other equipment.
- .7 Lubrication: Provide accessible lubricating means for bearings, including permanent lubrication "Lifetime" bearings. Extended grease nipples to be supplied.

1.5 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other divisions.

1.6 TRIAL USAGE

- .1 Engineer may use equipment and systems for test purposes or for continuity of operation prior to acceptance. Supply labour, material, and instruments required for testing & operation.

1.7 PROTECTION OF OPENINGS

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

1.8 ELECTRICAL

- .1 Electrical work to conform to Division 26 including the following:
 - .1 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems. Refer to Division 26 for quality of materials and workmanship.
- .2 Any costs associated with deviation of mechanical equipment rating affecting electrical Division 26 shall be carried by the mechanical contractor.
- .3 All control wiring & conduit associated with EMCS & HVAC controls shall be provided by Divisions 20, 21, 22, 23 & 25 including power wiring to all control panels & other field mounted control devices. Emergency power circuits are provided by Division 26 in the vicinity of the power source.

1.9 PAINTING

- .1 To Section 09 91 23 - Interior Painting.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Prime and touch up marred finished paintwork to match original. Use primer or enamel to match original. Do not paint over nameplates.
- .4 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.
- .5 Hangers, supports, and equipment fabricated from ferrous metals shall be given at least one coat of corrosion resistant primer paint before shipment to job site.
- .6 Touch-up damaged surfaces of all mechanical equipment and materials, to the satisfaction of Engineer. Use primer or enamel to match original. Do not paint over nameplates.

1.10 SPARE PARTS

- .1 Furnish spare parts, indicated in various section, and as follows:
 - .1 One casing joint gasket for each size pump.
 - .2 One head gasket set for each heat exchanger.
 - .3 One glass for each gauge glass.
 - .4 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
 - .5 Six fusible links for each type of fire damper.
 - .6 Provide other spare parts as indicated in equipment description. Reference Spare Parts List in Appendix 'B'.

1.11 SPECIAL TOOLS

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.12 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste Reduction Workplan (WRW):
 - .1 Perform work in accordance with project's WRW. If one does not exist, provide the following:
 - .1 Identify opportunities for reduction, re-use and/or recycling of materials.
 - .2 Post workplan or summary where workers on site are able to review its content.
- .2 Materials Source Separation Program (MSSP):
 - .1 Perform all work in accordance with project's MSSP. If one does not exist, provide the following:
 - .1 Provide containers for collection of re-usable and/or recyclable materials.
 - .2 Transport off-site salvaged materials to authorized recycling facility or to users of material for re-use.
- .3 Disposal of Waste:
 - .1 Disposal of waste, volatile materials, mineral spirits, oil, paint thinner, etc. into waterways, storm or sanitary sewers is prohibited.
- .4 Storage, Handling and Protection:
 - .1 Store materials for re-use in a secure area as directed by project manager, where they will not be damaged. Provide protection of materials, as necessary.
 - .2 Unless otherwise specified, removed materials become the Contractor's property. Contractor shall be responsible for transport & delivery of non-salvageable items to a licensed disposal facility.

1.13 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Supply tools, equipment, and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting, and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Where specified elsewhere in Divisions 20, 21, 22, 23 & 25, manufacturers to provide demonstrations and instructions.

- .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Owner may record these demonstrations on video tape for future reference.
- .6 Furnish trained instructors to instruct Owner's operating staff in the operation, maintenance, and adjustment of all mechanical equipment; and instruct personnel on any changes to or modifications of any equipment made under terms of the guarantee.
- .7 The instructions shall take place during regular working hours before systems are accepted and turned over to Owner's staff.
- .8 Ensure that the Owner's operating personnel have received and been given opportunity to review the Operating and Maintenance Manuals prior to commencing instruction. Allow two full days on site for review of these manuals with Owner's personnel and for their instruction in operation and maintenance of all mechanical equipment.

1.14 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual in accordance with Div. 01 - General Requirements.
- .2 Operation and maintenance manual (O&M) to be approved by, and final copies deposited with, Engineer before final inspection.
- .3 For all equipment listed in O&M manuals provide a schedule detailing the supplied component, name, address & phone no. of equipment vendor, parts supplier, and warranty agent.
- .4 Operation data to include:
 - .1 Control schematics for each system including environmental controls.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
- .5 Maintenance data shall 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.
- .6 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified elsewhere.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing.

- .7 Approvals:
 - .1 Submit electronic format (pdf) copy of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless so directed by Engineer. PDF file to include tabs to allow navigation to each section of the manual.
 - .2 Make changes as required and re-submit as directed by Engineer.
 - .3 Upon acceptance by Engineer submit one (1) electronic format (pdf) and three (3) hardcopies of O&M manuals to Owner.
- .8 Additional data:
 - .1 Prepare and insert additional data into operation and maintenance manual when the need becomes apparent during demonstrations and instructions specified above.

1.15 ACCEPTABLE PRODUCTS

- .1 Design is based on first manufacturer's name under acceptable products. Subsequent manufacturer's names indicate that those named are acceptable providing they meet specifications and space limitations and are subject to acceptance by Shop Drawing Review.
- .2 All manufacturers and manufacturer representatives shall separate pricing by major piece of equipment, equipment type, and/or service when submitting to bidding contractors. Lump sum values are not to be submitted to contractors. Manufacturer & representatives providing only lump sum pricing will be disqualified from tender.

1.16 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit single electronic (pdf) copy of shop drawings and product data along with transmittal, in accordance with Div. 01 - General Requirements. Hard copy shop drawings shall not be accepted.
- .2 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. e.g. access door swing spaces.
- .3 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on full equipment performance curves.
 - .4 Manufacturer to certify as to current model production.
 - .5 Certification of compliance to applicable codes.
- .4 The information to be indicated on manufacturers' shop drawings submitted for review shall include the following:
 - .1 General arrangement drawings showing component parts. Where the equipment proposed, or a component part thereof, includes modifications to a manufacturers' standard to meet the requirements of a specification, a complete assembly drawing must be submitted.
 - .2 Overall dimensions, roughing-in dimensions, and clearance dimensions of all major components.
 - .3 Mounting details and dimensions.

- .4 Complete certified performance data for the specified application with particular reference to rate of flow, operating pressure, and temperatures, entering and leaving conditions of air or fluid, operating weights, operating limitation, electrical characteristics, and BHP requirements.
- .5 Gauge of fabricated material and finish specification.
- .6 Vibration isolators and resilient hangers stating locations and weight distribution.
- .7 Electrical wiring diagrams, control panel boards, motor test data, motor starters and controls for electrically operated equipment furnished by mechanical trades.
- .5 Review of shop drawings or detail drawings will not relieve the obligation of ensuring that the equipment, materials, or layouts meet the functional requirements of the specifications, and that all necessary mounting space and clearance requirements are met. Thus, the Engineer's review is for assistance only.
- .6 No equipment will be accepted on the job site without shop drawings having been reviewed by the Engineer.

1.17 CLEANING

- .1 Prior to turnover to client, clean interior and exterior of all new systems. Replace all air & hydronic filters on new & modified systems. Vacuum interior of new and modified ductwork and air handling units.

1.18 AS-BUILT DRAWINGS

- .1 Site records:
 - .1 Mechanical sub-contractor shall mark all changes as work progresses and as changes occur.
 - .2 On a weekly basis, transfer information to record set of documents, revising to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing (TAB), 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 Engineer to submit AutoCAD or Revit files (as applicable) of mechanical drawings to contractor. Contractor shall modify CAD Drawings disks in accordance with Engineer CAD standards to reflect mechanical systems as installed.
 - .4 Submit electronic CAD files & hard copy to Engineer for approval and make corrections as directed.
 - .5 TAB to be performed using as-built drawings.
 - .6 Following approval, submit completed hard copy as-built drawings with Operating and Maintenance Manuals. Provide complete electronic as-built drawings in PDF and AutoCAD formats as well.
- .3 Submit copies of as-built drawings for inclusion in final TAB report.

1.19 CONFLICT/CO-ORDINATION DRAWINGS

- .1 For congested areas, prior to installation the contractor shall prepare interference drawings indicating proposed location of all systems & equipment including ductwork, piping, fans, diffusers, VAV boxes, conduits, lighting fixtures, etc. Prior to installation the contractor shall submit the drawings to the Engineer for review.
- .2 Architectural, structural, and electrical outlines may be shown to assist in coordination of work; confirm final arrangements before layout of mechanical work.
- .3 Do not scale.
- .4 Except where dimensioned, drawings indicate general mechanical layouts only.
- .5 Provide field drawings to show relative positions of various services. Obtain approval before beginning work. As a minimum provide layout/coordination drawings for mechanical rooms & corridor ceilings. Drawings must show coordination between all equipment and systems within the given space. All sub-trades to coordinate their work in conjunction with others.
- .6 Within six (6) weeks of Letter of Intent, mechanical & electrical trades to verify that proposed rooms, shafts, chases, reflected ceiling elevations, etc. provide adequate space for the installation of mechanical & electrical systems. This is to identify if there are any spatial shortcomings and to give adequate time for construction manager, consultants, and trades to make any dimensional changes and to make clear to all trades where items are to be installed. Installation and layout will not be on a first come first layout basis.
- .7 Request for information (RFI) to be submitted, if necessary, with contractor's proposed solution & issue of concern. RFI's must be submitted with proposed solution and clearly identify the issues or conflicts so Engineer can respond appropriately.
- .8 If this procedure is not followed the contractor shall be responsible for all modifications required to integrate the systems & equipment.
- .9 When requested by the City, contractor shall provide a single line isometric drawing of the proposed plumbing vent system.
- .10 Provide sleeving drawings showing all proposed sleeves for mechanical services, for review and approval by the architect & engineers. Sleeves shall be sized and dimensioned from nearest grid lines in both directions. Sleeving drawings shall be provided well in advance of slab pours to allow sufficient time for reviews and revisions as per comments from architect and engineers. Slab pouring shall not proceed until the associated sleeving drawing is approved. Sleeving drawings shall be fully coordinated with general contractor and all other trades. Any remedial work caused by failure to produce proper sleeving drawings shall be completed at the contractor's expense.

1.20 FEES AND PERMITS

- .1 Pay all fees and obtain all permits, taxes relating to the mechanical scope of work.
- .2 Additional costs associated with natural gas service shall be carried in the Div. 01 - General Requirements Section 01 21 10 - Allowances.
- .3 Water entry service charges associated with City water meter shall be carried in Div. 01 General Requirements Section 01 21 10 - Allowances. Obtain meter from site services contractor and install in accordance with City standards.
- .4 Contractor shall apply for and coordinate all required TSSA inspections/certifications. Contractor shall also complete and submit all forms required by TSSA and pay all associated fees.

1.21 FIRE ALARM BYPASS

- .1 Contractor to pay all costs associated with fire alarm bypass as required to perform mechanical work.

1.22 WARRANTY

- .1 Unless indicated otherwise provide one (1) year warranty starting at substantial completion for all new systems including materials, equipment & labour.

1.23 LOCATION OF MECHANICAL EQUIPMENT

- .1 Allow for 1500 mm of adjustment for exact location of air handling units, pumps, ducts, piping, etc. at no extra cost or credit.

1.24 ELECTRONIC DRAWINGS

- .1 Goodkey, Weedmark & Associates Limited will agree to supply the mechanical drawings in the form of electronic documents for the project to the User for the convenience of the User in carrying out its work. The User shall sign a License Agreement before drawings will be released.

1.25 CUTTING, PATCHING & CORING

- .1 Provide cutting, patching, and coring of all walls, ceiling & concrete slabs and other surfaces as required for mechanical work. Check with Owner or Building Management prior to core drilling and cutting of structure regarding building requirements and policies. Provide notification, clearance & protection.
- .2 The following procedure shall be followed for cutting & core drilling:
 - .1 Contractor to coordinate and summarize all new cores and openings in building structure. Contractor to investigate on site and locate any existing available hole which may be re-used for new systems.
 - .2 Contractor to prepare a layout sketch showing all existing openings & holes and required new openings & holes, with size and locations to the closest grid line in both directions and submit for review and approval by the architect & structural engineer.
 - .3 Structural engineer to provide written report outlining acceptance of the openings, as well as specific requirements for reinforcing at each location.
 - .4 Contractor to proceed with reinforcing tracing as per report and scanning for electrical conduit. Scanning to be completed using ground penetrating Radar (GPR) technology.
 - .5 Contractor shall identify at each location prior to coring and cutting the location, direction and layer of each reinforcing bar and conduit.
 - .6 Any core or opening where reinforcing steel was cut during the cutting & coring process must be retained on site, and the Contractor must inform the engineer with the following information: size of the reinforcing bar, reinforcing layer location (top steel or bottom slab steel) and direction of the bar (east - west or north - south).
- .3 Patch and make good surfaces cut, damaged or disturbed, to Engineer's approval. Match existing material, colour, finish, and texture or as indicated otherwise.
- .4 Provide dust tight screens or partitions to localize dust generating activities and for protection of finished areas of work, workers and public.

1.26 MECHANICAL COST BREAKDOWN

- .1 Upon award of contract, provide mechanical cost breakdown as per attached schedules for engineer's review and for progress billing purposes.
- .2 Costs such as site trailers, mobilization, shop drawings, engineering, etc. to be included as part of material and labour for each piece of equipment.
- .3 Controls programming and commissioning to be billed upon completion of commissioning.

- .4 Fire protection engineering costs to be included as part of material and labour costs.
- .5 Closeout documents including O&M manuals, as-built drawings, approved air & hydronic TAB reports, seismic letters, NFPA letters, etc. shall constitute 5% of the total mechanical construction cost and shall be approved as a single lump sum line item after submission to and final acceptance by Engineer. Contractor to indicate cost as a separate line item in Progress Billing.
- .6 Proposed billings to be submitted a minimum of fourteen (14) calendar days prior to submission of first billing, for review and approval by Engineer.
- .7 Equipment costs are to be broken down by system/equipment groupings and by floor and submitted with proposed billing submittal.

1.27 FINAL INSPECTION

- .1 Do not request final inspection until:
 - .1 Deficiencies are less than 25 items.
 - .2 All systems have been tested and are ready for operation.
 - .3 All air & water balancing has been completed as applicable.
 - .4 The Owner's operating personnel have been instructed in the operation of all systems and equipment.
 - .5 The complete operation and maintenance data books have been delivered to the Engineer.
 - .6 All inspection certificates have been furnished including but not limited to seismic certification, NFPA (Fire) 13 certification, City's final plumbing inspection.
 - .7 All record drawings have been completed and approved.
 - .8 All fire extinguishers have been installed.
 - .9 All spare parts and replacement parts have been provided and receipt of same acknowledged.
 - .10 The cleaning up is finished in all respects.
 - .11 Upon completion of above, contractor to request in writing for final site review with a minimal 72-hour notification.
- .2 Final installation shall be subject to the approval of the Engineer.

1.28 COMMISSIONING

- .1 Commissioning of the mechanical systems shall be in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Commissioning of the mechanical systems shall be in accordance with Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
- .3 Commissioning of the mechanical systems shall be in accordance with the commissioning specification. Mechanical contractor shall assist on all commissioning requirements.
- .4 Items to include the following:
 - .1 Plumbing:
 - .1 Domestic recirculation pumps
 - .2 Domestic hot water heater

- .2 Hydronic Heating:
 - .1 Boilers
 - .2 Circulation pumps
- .3 Ventilation:
 - .1 Ventilation for Penthouse
 - .2 Washroom exhaust
 - .3 Balancing
 - .4 Rooftop units
- .4 Fire Suppression:
 - .1 Sprinklers
 - .2 Fire pump/jockey pump & standpipe flow test
- .5 Controls:
 - .1 HVAC
 - .2 Alarms
 - .3 Operator workstation (OWS)
- .6 Mechanical contractor shall assist on all the INTEGRATED TESTING OF FIRE AND LIFE SAFETY SYSTEMS. Refer to Section 01 91 25 - Integrated Systems Testing.

1.29 PROGRESS BILLING-MECHANICAL CONTRACT PRICE \$

.1

Fire Protection		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
<i>Mobilization – Admin., Site Set-up</i>							
<i>Engineering</i>							
<i>Fabrication</i>							
<i>Sleeving</i>	<i>Material</i>						
	<i>Labour</i>						
<i>Sprinklers</i>	<i>Material</i>						
	<i>Labour</i>						
<i>Specialty</i>	<i>Material</i>						
	<i>Labour</i>						
<i>Pumps</i>							
<i>Close-out Documentation (5%)</i>							

Fire Protection		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
TOTAL ORIGINAL CONTRACT AMOUNT							
<i>Change Orders</i>							
<i>Architect's CO #</i>	<i>GWAL CCO or SI #</i>						
<i>#</i>	<i>#</i>						
<i>#</i>	<i>#</i>						
<i>Total Change Order Amount</i>							
TOTAL CONTRACT AMOUNT							

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

.2

HVAC		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
<i>Mobilization – Admin., Site Set-up</i>							
<i>Drafting & Coordinating</i>							
<i>Sleeving</i>	<i>Material</i>						
	<i>Labour</i>						
<i>Sheet Metal</i>	<i>Material</i>						
	<i>Labour</i>						
<i>Grilles, Diffusers</i>	<i>Material</i>						
	<i>Labour</i>						
<i>Silencers</i>	<i>Equipment</i>						
	<i>Labour</i>						
<i>R.T.U.'s and Curbs</i>	<i>Equipment</i>						
	<i>Labour</i>						
	<i>Start-up</i>						
<i>Smoke/Fire Dampers</i>	<i>Equipment</i>						
	<i>Labour</i>						

HVAC		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Insulation	Material						
	Labour						
Close-out Documentation (5%)							
TOTAL ORIGINAL CONTRACT AMOUNT							
Change Orders							
Architect's CO #	GWAL CCO or SI #						
#	#						
#	#						
Total Change Order Amount							
TOTAL CONTRACT AMOUNT							

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

.3

Controls		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Mobilization – Admin., Site Set-up							
Hardware	Equipment						
	Labour						
Wiring	Material						
	Labour						
Close-out Documentation (5%)							
TOTAL ORIGINAL CONTRACT AMOUNT							
Change Orders							
Architect's CO #	GWAL CCO or SI #						
#	#						
#	#						

Controls	Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Total Change Order Amount						
TOTAL CONTRACT AMOUNT						

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

.4

Plumbing		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Mobilization – Admin., Site Set-up							
San. Storm Underground Piping & Floor Drains	Material						
	Labour						
Sleeving	Material						
	Labour						
San. Storm Above Ground Piping & Roof Drains	Material						
	Labour						
Domestic Water Piping	Material						
	Labour						
Heating Water Piping	Material						
	Labour						
Gas Piping	Material						
	Labour						
Plumbing Equipment							
Boilers	Equipment						
	Labour						
	Start-up						
Hot Water Tanks	Equipment						
	Labour						
	Start-up						

Plumbing		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
<i>Pumps</i>	<i>Equipment</i>						
	<i>Labour</i>						
	<i>Start-up</i>						
<i>Expansion Tanks</i>	<i>Equipment</i>						
	<i>Labour</i>						
<i>Reheat Coils</i>	<i>Equipment</i>						
	<i>Labour</i>						
	<i>Start-up</i>						
<i>Plumbing Fixtures</i>	<i>Equipment</i>						
	<i>Labour</i>						
<i>Insulation</i>							
<i>Domestic</i>	<i>Material</i>						
	<i>Labour</i>						
<i>Heating</i>	<i>Material</i>						
	<i>Labour</i>						
<i>Close-out Documentation (5%)</i>							
TOTAL ORIGINAL CONTRACT AMOUNT							
<i>Change Orders</i>							
<i>Architect's CO #</i>	<i>GWAL CCO or SI #</i>						
<i>#</i>	<i>#</i>						
<i>#</i>	<i>#</i>						
<i>Total Change Order Amount</i>							
TOTAL CONTRACT AMOUNT							

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Ontario Regulation
 - .1 ONTARIO OBC, Ontario Building Code Compendium.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA (Fire) 14, Standard for the Installation of Standpipe and Hose Systems.
 - .3 NFPA (Fire) 20, Standard for the Installation of Stationary Pumps for Fire Protection.
- .3 National Research Council Canada
 - .1 NRCC NBCC, National Building Code of Canada.

1.3 DEFINITIONS

- .1 SRS: acronym for Seismic Restraint System.

1.4 QUALIFICATIONS

- .1 Prime mechanical contractor shall engage a Seismic Engineer who shall be responsible for all mechanical sections to ensure all mechanical sections listed in Item 1.1.1 are covered. Prime mechanical contractor shall ensure the Seismic Engineer is a Professional Engineer holding a Certificate of Authorization in the Province of Ontario with a minimum of 5 years' experience in seismic design and is covered with a minimum of \$2 million Professional Liability Insurance.
- .2 The Manufacturer shall be a member of VISCMA (Vibration Isolation and Seismic Control Manufacturers Association). They shall have a letter issued to their Supplier confirming that they have reviewed and accepted the engineering practices used by the Seismic Engineer. The letter shall also state that the manufacturer accepts the Supplier to act as their representative for the product.
- .3 Acceptable Suppliers: HTS Engineering, Master Group, E.H. Price and Capital Seismic. Alternate to be approved by Addendum (only).

1.5 GENERAL DESCRIPTION

- .1 This section covers design, supply, and installation of complete SRS for all systems, equipment specified for installation on this project. This includes fire protection piping & mechanical equipment and systems, both vibration isolated and statically supported.
- .2 SRS to be fully integrated into & compatible with:
 - .1 Noise and vibration controls specified elsewhere in this project specification.
 - .2 Structural, mechanical, electrical design of project.
- .3 During a seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position unless noted otherwise.

February 2026

- .4 Specified critical systems as noted below must remain operational during and after a seismic event:
 - .1 All systems for buildings as listed in OBC Table 4.1.8.18 - non-structural components.
 - .2 Life safety systems.
 - .3 Natural gas & fuel oil systems.

1.6 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Seismic Engineer shall be a Professional Engineer specializing in design of SRS and registered in Province of Ontario. The following submittals shall bear the SRS Design Engineer's seal and signature:
 - .1 A complete list of documents reviewed & list of exclusion.
 - .2 Full details of design criteria, calculations for all equipment & associated systems.
 - .3 A spreadsheet identifying all equipment requiring or not requiring seismic restraints and include all calculations.
 - .4 Copy of shop drawings and product data sent to Structural Engineer for review of connection points to building structure.

1.7 FINAL CERTIFICATION SUBMITTAL

- .1 Seismic Engineer shall be a Professional Engineer specializing in design of SRS and registered in Province of Ontario. The following shall bear the SRS Design Engineer's seal and signature:
 - .1 SRS installation inspections.
 - .2 SRS final certification letter for the project.
- .2 The Fire Protection Contractors shall be responsible for their respective discipline as it relates to Seismic restraints system. The contractor shall adhere to Section 20 05 49.01 and/or more stringent code (i.e. NFPA (Fire) 13, 14 & 20). Prime mechanical contractor to compile all of the above, review and submit for the record.
- .3 The final certification letter shall be formatted to identify the following within the body of the letter:
 - .1 The date of the final inspection.
 - .2 A statement that lists ALL contract documents which were reviewed including but not limited to the mechanical drawings, project change orders, site instructions, etc.
 - .3 A statement which clearly identifies any exclusions of scope of service.
 - .4 A statement that certifies the complete mechanical seismic installation meets the latest version of OBC & applicable codes & standards.

1.8 MAINTENANCE DATA

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 20 05 01 - Mechanical General Requirements.

February 2026

PART 2 PRODUCTS

2.1 GENERAL

- .1 Definitions
 - .1 Seismic System: isolation and seismic restraint products supplied by one supplier.
 - .2 Manufacturer: manufacturer of the isolation and seismic restraint system.
 - .3 Supplier: manufacturers' and seismic engineer's representative
- .2 Each contractor shall use one Supplier to provide seismic design, isolation, and seismic restraint.
- .3 Seismic restraints are to be provided for all operational and functional components of building services in accordance with the current Ontario Building Code, and NFPA (Fire) 13, 14 & 20.
- .4 The contractor shall utilize a Supplier familiar with the design of seismic systems to provide a comprehensive package of isolation and seismic restraint for the project. Provide detailed shop drawings showing the proposed restraint system for all required equipment, piping, and ductwork on the project. The shop drawings submittals shall include all items listed in Item 1.6.
 - .1 Acceptable Manufacturers: Kinetics / Vibron, Tecoustics, Mason, Gripple Seismic.
 - .2 Alternates to be approved by Addendum only.
- .5 Cable restraint systems, rod stiffener clamps and seismic isolator capacities to be verified by an independent test laboratory. Connection materials and site-specific designs to be by the Seismic Engineer. The Seismic Engineer may specify material and anchors provided by the contractor where this is appropriate. It is the contractors' responsibility to ensure that the Seismic Engineers' requirements and specification have been met.
- .6 At the completion of the project, the Supplier and the Seismic Engineer shall review the installations on site, and shall prepare a written report, with a sealed letter from the Seismic Engineer, certifying that the installations have been completed in accordance with their design and shop drawings. Refer to item 1.1.

2.2 SEISMIC FORCE

- .1 The Importance Factor for this project is:
 - .1 $I = 1.3$ - Schools.
- .2 The site classification for seismic site response and shear wave velocity parameters shall be as indicated on structural documents and as recorded in the geotechnical report.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.
- .2 Install SRS at least 25 mm from all other equipment, systems, services.
- .3 Co-ordinate connections with all disciplines.

3.2 INSPECTION AND CERTIFICATION

- .1 SRS to be inspected and certified by Manufacturer upon completion of installation.

February 2026

- .2 Seismic Design Engineer shall provide written report to Engineer certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.

3.3 COMMISSIONING DOCUMENTATION

- .1 Upon completion and acceptance of certification, hand over to Engineer complete set of construction documents, revised to show "as-built" conditions.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit catalogue details for each type of door illustrating profiles, dimensions, and methods of assembly.

PART 2 PRODUCTS

2.1 ACCESS DOORS

- .1 Supply and install as necessary to gain access to all concealed mechanical equipment for operating, inspecting, adjusting, servicing.
- .2 Sizes: Except as indicated otherwise, to be minimum sizes as follows:
 - .1 For body entry: 600 x 600 mm (24" x 24").
 - .2 For hand entry: 300 x 300 mm (12" x 12").
- .3 Construction: Rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180°.
- .4 Materials
 - .1 Tiled or marble surfaces and other special areas: Stainless steel with brushed satin or polished finish as directed by Consultant.
 - .2 All other areas: Prime coated steel.
- .5 Fire Rating
 - .1 Access doors fire rating to match that of wall, ceiling, or floor the access door is installed in. Coordinate with architectural drawings.

2.2 EXCLUSIONS

- .1 Lay-in tile ceilings. In this instance, use unobtrusive identification locators.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Installation in accordance with Manufacturer's installation instructions for particular surface.

3.2 LOCATION

- .1 Location: Ensure that equipment is clearly within view and accessible for operating, inspecting, adjusting, servicing without the need for special tools.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Sanitary Engineering (ASSE)
 - .1 ASSE (Plumbing) 1015, Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B64 SERIES, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B64.10/B64.10.1, Selection and Installation of Backflow Preventers/Maintenance and Field Testing of Backflow Preventers.
- .3 Factory Mutual.
- .4 National Fire Protection Association
 - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems.
- .5 NSF International (NSF)
 - .1 NSF/ANSI/CAN 61, Drinking Water System Components - Health Effects.
- .6 Ontario Regulation
 - .1 ONTARIO OBC, Ontario Building Code Compendium.
- .7 Underwriters Laboratories of Canada (ULC)

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements and in accordance with NFPA (Fire) 13, working plans and design requirements.
- .2 Pipe layout shall be the Contractors responsibility and fully coordinated with other trades.
- .3 Contractor shall submit shop drawing documents to Factory Mutual in accordance with Factory Mutual Standards; Contractor shall pay for all cost associated with submission.

1.4 ENGINEERING DESIGN CRITERIA

- .1 Design system in accordance with NFPA (Fire) 13 using following parameters:
 - .1 System shall be wet pipe systems as indicated.
 - .2 All areas shall be designed for hazard coverage indicated with design area and associated densities.
 - .3 Pipe size and layout:
 - .1 Hydraulic design.

- .2 Sprinkler layout to NFPA (Fire) 13 and with sprinkler centred in short direction of ceiling tile and no less than 300 mm from the tile's edge. Sprinkler contractor shall be responsible to provide sprinkler and piping layout fully coordinated with other systems.
- .3 The hydraulic design shall be sized to accommodate the highest and most remote zones and where indicated accommodate future building addition.
- .4 Allow for additional sprinklers and pipe distribution to suit electrical, architectural, and structural coordination.
- .5 Sprinklers shown are for architectural coordination, coverage to suit NFPA (Fire) 13 requirements. Provide additional sprinklers as required.
- .4 Water supply:
 - .1 Base design on NFPA (Fire) 13 and obtain water supply data from nearest fire hydrant. Hydraulic calculations shall commence at water main connection at street. Provide as part of hydraulic calculation submission, fire hydrant flow test data and deduct 10% as safety factor based on available pressure value.
- .5 Drawings and calculations shall be certified by a Professional Engineer licensed in the Province of Ontario.
- .6 Sprinkler system to be seismically restrained to Ontario Building Code and NFPA (Fire) 13 requirements.
- .7 Final installations to be reviewed by Professional Engineer licensed in the Province of Ontario. NFPA (Fire) 13 compliance letter to be stamped by Hydraulic Design Engineer and submitted at end of contract.

1.5 DRAWING PREPARATION

- .1 Review architectural, structural, mechanical, and electrical drawings to determine interferences affecting the distribution layout prior to shop drawing submission.

1.6 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

1.7 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Provide spare sprinklers and tools as required by NFPA (Fire) 13.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA (Fire) 13.
- .2 Fittings and joints to FM and NFPA (Fire) 13:
 - .1 Ferrous: screwed, welded, flanged, or roll grooved.
 - .2 All exposed piping shall be rigid piping.

- .3 Flexible sprinkler drops:
 - .1 Braided flexible stainless steel sprinkler drops, cULus and FM listed for fire protection service for installation on suspended ceiling grids, wood or metal stud/joist or furring channels.
 - .2 25 mm (1") nominal ID braid hose and fitting made of 304 stainless steel, 1206 kPa (175 psi) maximum working pressure, 178 mm (7") minimum bending radius within length of 750 mm to 1800 mm as per cULus. The maximum amount of allowable bends as per cULus are as follows: 750 mm (36") (5 bends); 1200 mm (48") (8 bends); 1500 mm (60") (10 bends); 1800 mm (72") (12 bends).
 - .3 Inlet nipple 25 mm (1") NPT with straight or 90° reducer for 13 mm (½") or 20 mm (¾") NPT sprinkler.
 - .4 A steel bracket with square bar, adjustable centre bracket and adjustable end brackets suitable for ceiling types. End bracket shall have permanent securement to ceiling system.
 - .5 Acceptable material: Victaulic Model VicFlex AH2; Viking model VKFD28B.
- .4 Valves:
 - .1 ULC and FM listed for fire protection service.
 - .2 Up to NPS 2: bronze, screwed ends, OS&Y rising stem gate or ball valve.
 - .3 NPS 2½ and over: cast iron, flanged or roll grooved ends, OS&Y rising stem gate or butterfly type.
 - .4 Check valves: swing type as above.
 - .5 Ball drip check valve.
- .5 Pipe hangers:
 - .1 FM and ULC listed for fire protection services.
- .6 Sprinkler system shall be rated at 1380 kPa (200 psi).

2.2 BACKFLOW PREVENTER

- .1 Double Check Valve Assembly (DCVA):
 - .1 Lead free construction, 304 stainless steel body, stainless steel fasteners and springs. Checks removable for maintenance. Rated for 60°C (140°F) and 1207 kPa (175 psi). Complete with grooved end butterfly valves with integral supervisory switches. Certified to CSA B64.5. ULC & FM listed. ASSE 1015 and NSF/ANSI/CAN 61 compliant.
 - .2 Provide suitable supervisory switches, where not integral to backflow preventer shut off valves.
 - .3 Acceptable material: Watts 757, Zurn 350AST.
- .2 All backflow preventers shall be selected and installed in accordance with OBC & CSA B64.10.

2.3 SPRINKLERS

- .1 Classrooms, corridors, washrooms and common spaces: Concealed sprinkler
- .2 Mechanical rooms, electrical rooms, and support spaces: Pendant resistant.
- .3 Provide wire guards in all mechanical rooms, storage areas, electrical rooms, and elevator machine room.

- .4 All sprinklers shall have low zinc content (less than 10%) brass alloy and metal to metal sealing mechanism in the water ways.
- .5 Acceptable materials: Viking, Grinnell, Victaulic, and Tyco.

2.4 CONCEALED SPRINKLER

- .1 Fully concealed pendent, quick response for hazard coverage as indicated, 5.6 K factor, enclosed escutcheon, separate two-piece design of mounting cup and coverplate, internal threaded closure, 68°C (155°F) rated, 13 mm (½") adjustment, FM approved, chrome finish, glass bulb type and white finish cover.

2.5 PENDANT SPRINKLER

- .1 Pendant, quick response for hazard coverage as indicated, 5.6 K or factor, adjustable chrome escutcheon, FM approved, chrome finish, glass bulb type; 68°C (155°F) rated, 13 mm (½") orifice.

2.6 SUPERVISORY SWITCHES

- .1 General: to NFPA (Fire) 13 and ULC/FM listed for fire service.
- .2 Die-cast enclosure over, die-cast base, all part corrosion resistant finish, paint finish.
- .3 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
 - .2 Cover tamper activated by cover removal.
 - .3 Two sets of SPDT contacts, 15.0 Amps @ 125/250 VAC, 2.5 Amps @ 30 VDC resistive.
- .4 Flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
 - .2 0.63 l/s (10 GPM) Minimum flow rate.
 - .3 Cover tamper activated by cover removal.
 - .4 Two sets of SPDT contacts, 15.0 Amps @ 125/250 VAC, 2.0 Amps @ 30 VDC resistive.
 - .5 Mechanical retard, adjustable from 10-90 seconds.
- .5 Pressure alarm switch:
 - .1 With normally open and normally closed contacts and supervisory capability.
 - .2 On-off differential 6.9 kPa (1 psi) minimum.
 - .3 Visible pressure indication: 206-1338 kPa (30-165 psi).
 - .4 Adjustable range: 172-1207 kPa (25-175 psi).
 - .5 Maximum operating pressure: 1207 kPa (175 psi).
 - .6 SPDT for use with normally open or normally closed circuits, 250 VAC 15 A ¼ HP, 125 VAC 15 A 1/8 HP, 250 VDC 0.2 A, 125 VAC 0.4 A, 30 VDC 2.0 A.
 - .7 Die-cast aluminum cover with enamel red paint finish, zinc plated steel base.

2.7 FIRE DEPARTMENT CONNECTION

- .1 Fully recessed type, 100 mm x 65 mm x 65 mm with "SPRINKLER" identification, polished chrome finish c/w caps and chains.

- .2 Reference drawing for exact identification.

2.8 TEST HEADER

- .1 Recessed test header for testing backflow preventer.
- .2 Cast brass construction with polished chrome finish with escutcheon plate reading "TEST HEADER" c/w cap & chains.
- .3 FM & ULC listed and rated pressure of 2068 kPa (300 psi).

2.9 PRESSURE GAUGES

- .1 ULC listed and to Section 23 05 19.01 - Thermometers and Pressure Gauges.
- .2 Shall have maximum limit of not less than twice normal working pressure at point where installed.

2.10 INSPECTOR TEST STATION

- .1 One piece design test and drain assembly, FM/ULC listed, 1034 kPa rated.
- .2 Approved materials: Victaulic, A.G.F. Manufacturing Inc., National Fire Equipment Ltd. test and drain assembly.

2.11 SIGNS

- .1 Signs for control drain and test valves: to NFPA (Fire) 13.

2.12 SPARE PARTS CABINET

- .1 For storage of maintenance materials, spare sprinklers, and special tools.
- .2 Construct to sprinkler manufacturers standard.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install, inspect, and test to acceptance in accordance with Factory Mutual's requirements and NFPA (Fire)13.
- .2 Testing to be witnessed by Authority having jurisdiction.
- .3 Test station to be piped to test drain riser.
- .4 Install and test equipment to manufacturers' standards.
- .5 Provide adequate pipe supports and bracing as per NFPA (Fire) 13 requirements and as follows:
 - .1 Fire protection contractor shall carry a structural engineer to design and certify the support system for any piping distribution system exceeding 100 mm (4") or where piping is grouped such that the distributed weight exceeds the building structure limits. (Note: In steel building structure the piping supports shall never be supported by a single joist or off the bottom chord of the joist or truss.
- .6 Allow for pipe offsets due to structure, equipment, duct, or other pipe interferences.
- .7 Paint all piping in damp/corrosive environments (such as outdoors, within parking/repair garages, etc.) with corrosion resistant, red paint.

3.2 TESTING

- .1 Test jockey pump to manufacturers standards and NFPA (Fire) 13. Submit startup report and test report.
- .2 Install excess pressure pump across alarm valve in accordance with manufacturers instructions.
- .3 Pressure test all piping systems as required by NFPA and provide pressure test verification documents.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 National Fire Protection Association NFPA
 - .1 NFPA (Fire) 10, Portable Fire Extinguishers.
- .2 Ontario Fire Code.
- .3 Underwriters Laboratories of Canada
 - .1 CAN-ULC-S508, The Rating and Fire Testing of Fire Extinguishers.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

- .1 (FE1) Stored pressure dry chemical type with heavy duty steel cylinder, positive on/off operation, waterproof stainless steel gauge, shut-off nozzle, ULC labelled for A, B and C class protection c/w wall mounting bracket. Size 4.54 kg, 3A-10BC rating. Reference drawing schedule for type and mounting.

2.2 RECESSED CABINET

- .1 Recessed type cabinet with 22 gauge primed & painted tub, 16 gauge front polished stainless steel finish, semi-recessed piano hinged door, and clear glass front. Flush stainless steel door hatch.
- .2 Acceptable material: National Fire CE-950-3 series, Canadian Fire Equipment.

2.3 IDENTIFICATION

- .1 Identify extinguishers in accordance with recommendations of NFPA (Fire) 10, ULC S508 and Ontario Fire Code.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install extinguishers where indicated and at a height in accordance with NFPA (Fire) 10 and Ontario Fire Code.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 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.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.
- .2 Data to 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 DOMESTIC HOT WATER CIRCULATING PUMPS

- .1 Capacity: reference schedule.
- .2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel, or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 100 psi (689 kPa) wp and 60°C (140°F) continuous service.
- .3 Motor: drip-proof, with thermal overload protection.
- .4 Supports: provide as recommended by manufacturer.
- .5 Acceptable materials: Armstrong, Grundfos and Xylem (Bell & Gossett).

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.

3.2 FIELD QUALITY CONTROL

- .1 Check power supply.
- .2 Check starter protective devices.
- .3 Start-up, check for proper and safe operation.
- .4 Check settings and operation of all hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature, and other protective devices.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150 and 300.
 - .5 ASME B16.51, Copper and Copper Alloy Press-Connect Pressure Fittings.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .2 ASTM B88M, Specification for Seamless Copper Water Tube (Metric).
 - .3 ASTM F492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings
 - .4 ASTM F3226/F3226M-19, Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems.
- .3 American Water Works Association (AWWA)
 - .1 AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 International Association of Plumbing and Mechanical Officials (IAPMO)
 - .1 IAPMO PS117 - Press and Nail Connections.
- .5 International Code Council (ICC)
 - .1 ICC LC 1002, Press-connection Fittings for Potable Water Tube and Radiant Heating Systems.
- .6 National Science Foundation (NSF)
 - .1 NSF/ANSI/CAN 61, Drinking Water System Components – Health Effects.
 - .2 NSF/ANSI/CAN 372, Drinking Water System Components – Lead Content.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 COPPER PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

February 2026

- .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.
- .3 Piping to be made in Canada or USA.

2.2 FITTINGS FOR COPPER PIPING

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ASME B16.15.
- .3 Cast copper, solder type: to ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ASME B16.22.
- .5 Press fittings:
 - .1 Fittings shall conform to ASTM F3226, ICC LC 1002, ASME B16.51, IAPMO PS 117, NSF 61, and NSF 372.
 - .2 Fittings ½-inch through 4-inch suitable for use with ASTM B88 copper tube type K, L, or M.
 - .3 Fittings ½-inch through 1-1/4-inch suitable for use with annealed copper tube.
 - .4 Press Fittings shall have a valid Ontario Building Material Evaluation Commission Authorization (BMEC).
 - .5 Cast copper alloy fittings:
 - .1 Alloy: Copper alloy - UNS C12200.
 - .2 Zero lead silicon bronze alloy - C87710 (cast) or C87700 (machined).
 - .3 Shall not be bismuth bronze or yellow brass.
 - .6 EPDM elastomeric sealing element shall be peroxide cured for resistance to chloramines.
 - .7 Fittings shall be designed to visibly leak during pressure testing if fittings are unpressed.
 - .8 2-1/2 inch through 4-inch fittings shall have stainless-steel grip ring with bidirectional teeth, PBT separator ring, and EPDM sealing element at each press connection.
 - .9 Acceptable materials: Viega ProPress.

2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111/A21.11.
- .2 Bolts, nuts, hex head, and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 lead free solder. No lead content in excess of 0.2%.
- .4 Polytetrafluoroethylene (PTFE) thread seal tape: for threaded joints.
- .5 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner. Bronze or brass ball valves are an acceptable dielectric fitting where applicable.

2.4 VALVES

- .1 Refer to Section 23 05 23 - Valves.

February 2026

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Install pipe work in accordance with Section 23 05 05 - Installation of Pipe Work, supplemented as specified herein.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Install DCW piping below and away from DHW and DHWR and other hot piping so as to maintain temperature of cold water as low as possible.
- .6 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .7 Install isolation valves at all branch take-offs and to isolate each piece of equipment, and as indicated.
- .8 Allow for pipe offsets due to structure, equipment, duct, or other pipe interferences.
- .9 Press fittings shall be selected and installed in accordance with manufacturer's installation instructions, using manufacturer's recommended tools. Installers shall be trained by manufacturer.
- .10 Ensure that all tools used with stainless steel pipe (i.e. brushes, files, grinders and cutting tools) have not come in contact with carbon steel pipe to prevent cross contamination.
- .11 All grooved components shall be of one manufacturer. Contractor shall verify coupling pressure ratings on Schedule 10 stainless steel prior to installation. Grooved pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Install in accordance with manufacturer's latest recommendations. A factory trained representative shall periodically visit the job site and review the installation for best practices. The installing Contractor shall correct any identified deficiencies. Any product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined prior to the completion of the project.

3.2 PRESSURE TESTS

- .1 Refer to Section 23 05 05 - Installation of Pipework.
- .2 Test pressure: greater of 1½ times maximum system operating pressure or 860 kPa.

3.3 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean. Let system flush for additional 2 h, then draw off another sample for testing. Submit test results to Engineer.

3.4 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.

February 2026

3.5 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and to the approval of Engineer.
- .2 Upon completion, provide laboratory test reports on water quality for Engineer approval.

3.6 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.
- .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 DHW storage tank up to design temperature slowly.
 - .4 Monitor DHW and DHWR 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.

3.7 PERFORMANCE VERIFICATION

- .1 Timing:
 - .1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 TAB DHWR in accordance with Section 23 05 93 - Testing Adjusting and Balancing (TAB) of Mechanical Systems.
 - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .4 Verify performance of temperature controls.
 - .5 Verify compliance with safety and health requirements.
 - .6 Check for proper operation of water hammer arrestors. Run 10% of outlets for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .7 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

February 2026

.3 Reports:

- .1 In accordance with Section 20 05 01 - Mechanical General Requirements: Reports, using report forms as specified in Section 20 05 01 - Mechanical General Requirements: Report Forms and Schematics.
- .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D2564, Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B1800, Thermoplastic Non-pressure Piping Compendium.
- .3 Ontario Regulation
 - .1 ONTARIO OBC, Ontario Building Code Compendium.
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

PART 2 PRODUCTS

2.1 PIPING AND FITTINGS

- .1 DWV PVC (Polyvinyl Chloride):
 - .1 Application: below grade sanitary, storm & vent piping & fittings and above grade where combustible piping is permitted excluding OBC 3.2.6 (High-rise) applications and ceiling plenums.
 - .2 Pipe and Fittings: Drain, waste and vent pipe and fittings shall be certified to CSA B1800. When combustible pipe and fittings are used in buildings required to be of noncombustible construction, they shall be listed by ULC to the Standard CAN/ULC S102.2 and clearly marked with the certification logo indicating a flame-spread rating not exceeding 25.
 - .3 Acceptable material: IPEX System 15 DWV.
- .2 Fire & smoke resistant coated DWV PVC (Polyvinyl Chloride) piping & fittings:
 - .1 Application: Above grade sanitary, storm & vent piping & fittings where combustible piping is permitted including OBC 3.2.6 High-rise applications and within ceiling plenums.
 - .2 Pipe and Fittings: Drain, waste and vent pipe and fittings shall be certified to CSA B181.2 and when used in noncombustible construction, high-rise buildings, and air plenums, they shall be tested and listed in accordance with CAN-ULC-S102.2 and clearly marked with the certification logo indicating a flame-spread rating not exceeding 25 and a smoke-developed classification not exceeding 50.
 - .3 Acceptable material: IPEX System XFR 15/50 PVC-DWV.
- .3 Gasketed DWV PVC (Polyvinyl Chloride):
 - .1 Application: below grade sanitary & storm piping. Not permitted above grade.

- .2 Pipe and Fittings: Drain & waste pipe and fittings shall be certified to CSA B182.2. Gasketed joints shall withstand hydrostatic pressure levels of at least 100 kPa (15 psi) and a negative pressure of -75 kPa (-11 psi). Pipe connections shall be sealed via factory installed gasket without the need for solvent welding.
- .3 Pipe Thickness:
 - .1 For pipe sizes NPS 4 to 6: DR 28.
 - .2 For pipe sizes NPS 8 and above: DR 35.
- .4 Acceptable material: IPEX Ring-Tite.
- .4 Solvent Welding:
 - .1 Solvent cements shall be CSA certified and meet the requirements of ASTM D2564. One-step cement may be used for sizes from NPS 1.5 to 6. Two-step cement must be used in conjunction with primer on larger pipe sizes. Proper solvent cementing procedures must be followed at all times.
 - .2 The manufacturer shall be consulted prior to installation for proper solvent welding procedures and proper solvent cement requirements.
- .5 Expansion/Contraction:
 - .1 Compensation shall be made to accommodate expansion/contraction on the drainage system. It is recommended that there be compensation on every second floor for the vertical piping system. Consult pipe system manufacturer for specific details regarding approved compensation methods.
- .6 Compatibility:
 - .1 To ensure compatibility, performance and material quality, all pipe and fitting drainage system shall be produced by the same manufacturer.
- .7 Quality Control:
 - .1 The manufacturer of the pipe and fitting system shall be contacted prior to the installation to obtain precise installation instructions. Site meetings shall be arranged and include the Contractor, Manufacturer and Building Inspector.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.
- .2 Allow for locating of existing buried sanitary piping prior to excavating for connection of new services.
- .3 Bedding and backfilling should be in accordance with Russell Township standards and specifications.
- .4 Plastic pipe shall not be used on pumped sanitary & storm discharge.

3.2 TESTING

- .1 Test in accordance with OBC Part 7 requirements.
- .2 Pressure test buried systems before backfilling.
- .3 Hydraulically test to verify grades and freedom from obstructions.

- .4 Dye Testing:
 - .1 The sanitary and storm plumbing systems shall be dye-tested.
 - .2 On storm system dye tables (Fluorescein) shall be mixed with water to the manufacturer's instructions and introduced to each roof drain. The mechanical contractor shall determine if the dissolved fluorescein passed the downstream storm manhole, indicating a "Positive" dye test.
 - .3 On the sanitary system, dye tablets (fluorescein) shall be placed in each plumbing fixture or at discretion of certifying engineer. The mechanical contractor shall determine if the dissolved fluorescein passed the downstream sanitary manhole indicating a "Positive" dye test.
 - .4 A "Negative" dye test indicates that the building system is not connected to the appropriate system and mechanical contractor shall complete corrective action.
 - .5 Dye testing shall be conducted by contractor following below grade rough-in and following the complete above grade installation and finish work.
 - .6 Contractor to retain services of an independent professional engineer registered in Ontario to witness Dye testing. Provide letter stamped by engineer certifying successful completion of test.
- .5 Video Testing:
 - .1 Provide video scanning of underground sanitary and storm piping for review and contractor's approval prior to pouring of concrete. Repair deficiencies and re-scan as required. Submit final video to Engineer for record.
 - .2 Flush & video scan sanitary and storm piping for contractor's review and approval prior to building turnover. Repair deficiencies and re-scan as required. Submit final video to Engineer for record.

3.3 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 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME BPVC.IV, ASME Boiler and Pressure Vessel Code, Section IV: Heating Boilers.
- .3 Canada National Standard (CAN)/Canadian Standards Association (CSA)
 - .1 CSA B149.1, Natural Gas and Propane Installation Code.
 - .2 CSA 4.3:19/ANSI Z21.10.3, Gas Water Heaters - Volume III, Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S636, Standard for Type BH Gas Venting Systems.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 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 20 05 01 - Mechanical General Requirements.

1.5 WARRANTY

- .1 For the Work of this Section 22 30 05.1 - Domestic Water Heaters, the 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.
- .2 Contractor hereby warrants domestic water heaters in accordance with CCDC2 GC 24, but for number of years specified for each product.

PART 2 PRODUCTS

2.1 GAS (HIGH EFFICIENCY/CONDENSING DOMESTIC HOT WATER AND HEATER)

- .1 To CSA ANSI Z21.10.3 - Gas Water Heater and ASHRAE 90.1 compliant, with performance as indicated on drawing schedule. Thermal efficiency of minimum 92%.
- .2 Construction: water heater(s) shall be of the seamless glass lined steel tank construction in which the glass coating is applied to the water side surfaces of the tank after the tank has been assembled and welded. The condensing flue coil shall be coated on the flue gas side with acid

- resistant glass lining designed for use in condensing heaters. The tanks shall be foam insulated and equipped with a ASME rated temperature pressure relief valve. The water heater shall be UL listed, CSA listed and exceed the minimum efficiency requirements of ASHRAE 90.1.
- .3 Gas burner: the heater shall be suitable for sealed combustion direct venting using a 100 mm (4") diameter CAN-ULC S636 PVC air intake pipe and 100 mm (4") diameter CAN-ULC S636 PVC exhaust pipe for a total distance of 26 equivalent metres (85 equivalent feet) of vent and 30 equivalent metres (100 equivalent feet) of intake. The heater shall be factory assembled and tested. The power burner shall be of a design that requires no special calibrations on start up. The heater(s) shall be approved for 0 mm (0") clearances to combustibles.
 - .4 Provide 100 mm (4") dia. fusible PVC direct vent kit. Package as per manufacturer's recommendations.
 - .5 Controls: the controls shall be an integrated solid-state temperature and ignition control device with integral diagnostics, LED fault display capability and a digital display of temperature settings.
 - .6 Power: 120 volt single phase, 15 Amps.
 - .7 Three (3) year tank warranty.
 - .8 Provide condensate neutralization kit. Size as per manufacturer's recommendations.
 - .9 Acceptable material: Lochinvar Sheild Commercial, A.O. Smith Cyclone, Bradford white model EF-series, Rheem Spiderfire, or as per Alternative Material approval by Addendum in accordance with Instructions to Tenderers.

2.2 ACCESSORIES

- .1 Water Heater Pan:
 - .1 28 ga. aluminum, 65 mm (2½") high, 25 mm (1") CPVC drain connection.
 - .2 Select diameter such that pan extends minimum 50 mm (2") beyond water heater on all sides.
 - .3 Acceptable material: Oatey, or equal.
- .2 Water Safety valve:
 - .1 Resettable, testable, full port water isolation valve c/w actuator, water sensor and control module. Shuts off water when a leak is detected by water in the pan. Module includes two (2) colour LED light and audible alarm to indicate status. Operable by battery power or 120V plug, suitable for use with potable water from 0.6°C (33°F) to 104°C (220°F). Maximum shut-off pressure 862 kPa (125 psi).
 - .2 Acceptable material: Taco Leakbreaker.
- .3 BRV: Combination Ball Relief Valve:
 - .1 Lead free.
 - .2 Relief setting 515 kPa (75 psi).
 - .3 Acceptable material: Watts LFBRV, or equal.
- .4 Condensate Neutralizer:
 - .1 Wall mounted unit made of corrosion resistant materials.
 - .2 1 litre capsule containing the neutralizing media with an integral bypass.
 - .3 Neutralizer rated for gas fired appliances with a maximum input capacity of 115 kW.

2.3 TRIM AND INSTRUMENTATION

- .1 Drain valve: 25 mm with hose end.
- .2 Pressure gauge: 75 mm (3") dial type with red pointer and shut-off cock.
- .3 Thermowell filled with conductive paste for control valve temperature sensor.
- .4 ASME rated temperature and pressure relief valve sized for full capacity of the appliance being served, having discharge terminating over floor drain and visible to operators.
- .5 Magnesium anodes adequate for 20 years' of operation and located for easy replacement.

2.4 ANCHOR BOLTS AND TEMPLATES

- .1 Supply for installation by other Divisions.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Install natural gas fired domestic water heaters in accordance with CSA B149.1.

3.2 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up DHW heaters.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Sanitary Engineering (ASSE)
 - .1 ASSE (Plumbing) 1015, Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies.
 - .2 ASSE (Plumbing) 1017, Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems.
 - .3 ASSE (Plumbing) 1071, Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B64 SERIES, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B64.10/B64.10.1, Selection and Installation of Backflow Preventers/Maintenance and Field Testing of Backflow Preventers.
- .4 NSF International (NSF)
 - .1 NSF/ANSI/CAN 61, Drinking Water System Components - Health Effects.
- .5 Ontario Regulation
 - .1 ONTARIO OBC, Ontario Building Code Compendium.
- .6 Plumbing and Drainage Institute (PDI)
 - .1 PDI WH 201, Water Hammer Arresters Standard.
- .7 Underwriters Laboratories (UL)
 - .1 UL 873, Standard for Temperature-Indicating and -Regulating Equipment.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for items specified herein.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

- .2 Data to include:
 - .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.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

- .1 Floor drains and trench drains: to CSA B79.
- .2 FD1: Heavy duty floor drain; cast iron epoxy coated body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer, trap priming connection.
 - .1 Provide oval funnel with full opening grate where indicated (funnel).
 - .2 Provide 100 mm (4") full drain diameter hub drain extension on floor drain where indicated (hub).
 - .3 Acceptable material: Watts FD 320-1 (G-1 for oval funnel), Mifab, J.R. Smith, Zurn.

2.2 ROOF DRAINS

- .1 RD1: controlled flow; epoxy coated cast iron body, under deck clamp and sump receiver extension to suit roof construction, flashing clamp ring with integral gravel stop, bearing pan, flow control weir assembly, aluminum dome.
 - .1 Acceptable material: Watts RD 100 BEAD (K), Mifab, J.R. Smith, Zurn.

2.3 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.
 - .1 Acceptable material: Watts CO-380, J.R. Smith & Zurn.
- .2 Access covers:
 - .1 Wall access: face or wall type, stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs. Acceptable material: Watts, CO 480 (wall), CO 300 (floor), Zurn.
 - .2 Floor access: round cast iron body and frame with adjustable secured nickel bronze top cast box with anchor lugs, and.
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for unfinished concrete floors: nickel bronze round, gasket, vandal-proof screws. Acceptable material: Watts CO 200 XHR series, Zurn.
 - .3 Cover for terrazzo finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws. Acceptable material: Watts CO 200 U-1-6, Zurn ZX-1400-BP-Z.
 - .4 Cover for tile and linoleum floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws. Acceptable material: Watts CO 200 T-1-6, Zurn.

- .5 Cover for carpeted floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.
Acceptable material: Watts CO 200 RC-1-6, Zurn.

2.4 TRAP SEAL PRIMERS

- .1 Type 1: for use on urinal or water closet cold water line.
 - .1 Pressure drop activated type, all brass construction with "O" ring seals, 13 mm (NPT ½) male inlet & 13 mm (NPT ½) female outlet drip line connection with viewing holes, and removable filter screen. Trap primer shall have no adjustment. Operating range shall be 138 kPa (20 psi) to 861 kPa (125 psi). Operates on pressure drop of Minimum 20 kPa (3 psi). One (1) to six (6) drain taps per unit.
 - .2 Identify on as-built drawings the location of each trap seal primer.
 - .3 Ensure all trap seal primers are accessible for maintenance purposes and are connected to urinal or water closet cold water line. Trap line shall be from top of cold-water line and include a service valve. All to be serviceable from access doors.
 - .4 Acceptable materials: Mifab M-500, Watts, Zurn Z-1022, Smith controls 2694 distribution unit 2694A.
- .2 Type 2: for use on mop sink cold water line.
 - .1 Brass trap seal primer with removable poppet, integral vacuum breaker, access gasketed cover 13 mm (NPT ½) threaded inlet and outlet connections, complete with 13 mm (NPT ½) sweat connection adapters and 13 mm (NPT ½) drip line connection.
 - .2 Trap seal primers are listed with I.A.P.M.O. and CSA and are tested and certified to the ASSE 1018.
 - .3 Trap seal primers shall be installed minimum 305 mm (12") above the grid of a floor drain or flood level rim of equipment served.
 - .4 Operating range for trap seal primers is 138 kPa (20 psi) to 861 kPa (125 psi). Operates on pressure drop of Minimum 14 kPa (2 psi).
 - .5 Acceptable material: PPP Prime-pro, Mifab MI-TSP-3, Watts, Zurn, Smith Controls 2699-1.
- .3 Provide an air gap fitting serving each trap seal primer, if trap seal primer does not include an integral air gap or air space type vacuum breaker in accordance with CSA B64.10.

2.5 WATER HAMMER ARRESTORS

- .1 Copper construction, bellows, or piston type: to PDI-WH201.
 - .1 Acceptable material: Watts LF15M2 SERIES, J.R. Smith & Zurn Z-1700.

2.6 BACKFLOW PREVENTERS

- .1 Double Check Valve Assembly (DCVA):
 - .1 65 mm (2½"Ø) and Larger:
 - .1 Lead free construction, epoxy coated cast or ductile iron or 304 stainless steel body. Checks accessible for maintenance. Rated for 60°C (140°F) and 1207 kPa (175 psi). Complete with flanged end non-rising stem gate valves and strainer. Certified to CSA B64.5. ULC listed. ASSE 1015 and NSF/ANSI/CAN 61 compliant.
 - .2 Acceptable material: Watts 757 or LF709, Zurn Wilkins 350 or 350AST.

- .2 All backflow preventers shall be selected and installed in accordance with OBC and CSA B64.10.

2.7 BACKWATER VALVES

- .1 Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded cover.
 - .1 Acceptable material: Watts.
- .2 Access:
 - .1 Surface access.
 - .2 Access pipe with cover: maximum 300 mm (12") depth.
 - .3 Steel housing with gasketed steel cover.
 - .4 Concrete access pit with cover, as indicated.

2.8 STRAINERS

- .1 860 kPa (125 psi), Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
 - .1 Acceptable material: Wilkins S-XL, Watts equivalent is LF777SI.

2.9 EMERGENCY WATER MIXING VALVE FOR DRENCH OR COMBINATION EMERGENCY SHOWER

- .1 General:
 - .1 The Emergency shower mixing valve shall control and maintain the temperature of the water to the station. Unit shall be self contained and include a thermostatic water mixing valve, a dial thermometer on the outlet, union angle checkstops, wall mounting bracket, piping and fittings factory assembled and tested, top or bottom inlets and top outlet, unit set for 29°C (85°F) and a maximum temperature of 32°C (90°F). Unit must be able to be set to the correct temperature for the specific contaminant but must be locked in place to prevent changing of the temperature by accident. Unit shall be able to flow a minimum flow of 76 L/min. (20 GPM) at 205 kPa (30 PSI).
- .2 Construction:
 - .1 Solid bimetal thermostat directly linked to valve porting to control the intake of hot and cold water and compensate for supply temperature and pressure fluctuations.
 - .2 Thermostatic mixing valve can be set to the correct temperature for the application.
 - .3 Locking temperature regulator to prevent accidental movement set for 29°C (85°F).
 - .4 Mixing valve will close down on failure of cold-water supply.
 - .5 Mixing valve with special internal cold-water bypass capable of 76 L/min. (20 GPM) at 205 kPa (30 PSI) upon failure of hot water supply.
 - .6 Adjustable high temperature limit stop.
 - .7 Full 20 mm (¾") bottom inlets and 25 mm (1") top outlet.
 - .8 Integral wall support.
 - .9 View port in door with, dial thermometer (range -10 to 60°C (0 to 140°F)).
 - .10 Rough bronze finish.
 - .11 Exposed stainless steel cabinet with hinged door and cylinder lock.
 - .12 Union angle checkstops on inlets.
 - .13 Compliance with ISEA Z358.1 or ASSE 1071.

- .14 STSTL EXP - Exposed cabinet, Stainless steel.
- .15 IT - Inlet thermometers.
- .3 Acceptable material: Leonard TM-600-LF-STSTL EXP-IT, Powers.

2.10 EXPANSION TANKS

- .1 Horizontal or vertical steel pressurized removable bladder type expansion tank as per schedule.
- .2 ASME construction, steel shell construction.
- .3 Diaphragm sealed in heavy duty butyl material.
- .4 Polypropylene liner material certified to NSF/ANSI/CAN 61.
- .5 Working pressure: 862 kPa (150 psi) with ASME stamp and certification including Canadian Registration Number (CRN).
- .6 Working temperature: 93°C (200°F).
- .7 Stainless steel system connections.
- .8 Air pre-charged to initial fill pressure of system as per schedule.
- .9 Saddles for horizontal installation; base mount for vertical installation.
- .10 Supports: Provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- .11 Capacity: as per schedule.
- .12 Acceptable materials: Amtrol ST-C series, Calefactio, Xylem (Bell & Gossett), Watts DETA ASME series for potable.

2.11 MASTER DIGITAL MIXING VALVE

- .1 Lead free* digital water temperature control and monitoring system shall have LCD interface which is configurable on location and does not require factory pre-programming. System shall control water temperature to +/- 1°C in accordance with ASSE 1017 and during periods of low/zero demand and have a user-programmable high temperature alarm. Unit shall have Feed Forward or Predictive Control which anticipates changes in system demand and adjusts valve pre-emptively to maintain mixed setpoint.
- .2 System shall digitally monitor mixed outlet temperature and recirculation temperature. System shall control an engineer specified recirculation pump based on user-set return temperature limits. Controller shall integrate with building automation systems through terminal strip for local and remote alarms. System will also have a user-set and controlled, high-temperature sanitization mode for use as part of user power failure or loss of cold water, system will close the hot water supply. System shall be listed/approved to ASSE 1017, cUPC, NSF, CSA 24/UL 873. Unit shall be powered through 24V power supply and come complete with transformer for 120V direct connection.
- .3 Acceptable material: Bradley Digital Navigator, Leonard, Watts.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.2 FLOOR DRAINS

- .1 Floor drains to be installed at lowest point in floor and placed to ensure floor finishing is flush/slightly higher than strainer. Contractor to chip concrete around drains, lower assembly, patch concrete and provide floor finish should the installed elevation be unacceptable to Engineer.
- .2 Contractor to provide suitable means of protecting floor drains and cleanouts from damage during construction. Contractor to be responsible for turning over facility to Owner with floor drains and strainers in new condition. Damaged material shall be replaced with new at contractor's expense.

3.3 CLEANOUTS

- .1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.
- .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 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures.

3.5 BACKFLOW PREVENTERS

- .1 Pipe discharge to terminate over nearest drain or service sink.
- .2 Test and certify each backflow preventer and provide report for inclusion in the commissioning report.

3.6 BACKWATER VALVES

- .1 Install in access pit as indicated.

3.7 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 Engineer.
- .3 Install plastic tubing to floor drain.
- .4 Identify on as-built drawings the location of each trap seal primer.
- .5 Ensure all trap seal primers are accessible for maintenance purposes. Install access doors if required.
- .6 Install a minimum of 300 mm above the flood level rim of the fixture served, or greater as recommended by manufacturer's installation instructions.

3.8 STRAINERS

- .1 Install with sufficient room to remove basket.

3.9 WATER METERS

- .1 Install water meter spool piece provided by local water authority.
- .2 Install water meter as indicated and to Russell Township Standards.

3.10 MASTER THERMOSTATIC MIXING VALVE

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

3.11 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - Commissioning: General Requirements, supplemented as specified herein.
- .2 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.
- .3 Provide continuous supervision during start-up.

3.12 TESTING AND ADJUSTING

- .1 General:
 - .1 In accordance with Section 01 91 13 - Commissioning: General Requirements, supplemented as specified herein.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
 - .1 Pressure at fixtures: ± 70 kPa.
 - .2 Flow rate at fixtures: $\pm 20\%$.
- .4 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.
- .5 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.
- .6 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.

- .7 Roof drains:
 - .1 Check location at low points in roof.
 - .2 Check security, removability of dome.
 - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
 - .4 Clean out sumps.
 - .5 Verify provisions for movement of roof systems.
- .8 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .9 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .10 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .11 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.
- .12 Commissioning Reports:
 - .1 In accordance with Section 01 91 13 - Commissioning: Reports, supplemented as specified herein.
- .13 Training:
 - .1 In accordance with Section 01 91 13 - Commissioning: Training of O&M Personnel, supplemented as specified herein.
 - .2 Demonstrate full compliance with Design Criteria.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA B45 SERIES, Plumbing Fixtures.
 - .2 CAN/CSA B125, Plumbing Fittings.
 - .3 CSA /ASC B651, Accessible Design for the Built Environment.
- .2 Ontario Regulation
 - .1 ONTARIO OBC, Ontario Building Code Compendium.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate, for all 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 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 20 05 01 - Mechanical General Requirements.
- .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.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Fixture piping.
 - .1 Hot and cold-water supplies to each fixture:
 - .1 Supply stops shall be all brass with full turn brass seams and washer replaceable attachment shall be IPS inlet x compression OD outlet to fixture. All fixtures stop-valves shall be screwdriver type.
 - .2 Chrome plated in all exposed places.

.2 Waste:

- .1 Cast brass adjustable style P-trap with cleanout on each fixture not having integral trap.
- .2 Chrome plated in all exposed places.
- .3 Sink and lavatory heavy gauge P-traps shall be cast brass adjustable style with 17 ga. seamless brass wall bend. Attachment nuts shall be brass, no zinc allowed. P-traps to be removable/union type or to include cleanout.
- .4 Lavatory strainers shall be chrome-plated cast brass with 17 ga. seamless brass tailpiece.
- .5 All barrier-free lavatories and sinks shall have chrome plated offset tail piece in addition to P-trap with cleanout. Insulate P-trap and hot & cold-water pipes with pre-formed & finished surface insulation. Armaflex insulation and tape not acceptable.

.2 Fixtures:

- .1 Manufacture in accordance with CSA B45.
- .2 All products, where applicable, shall be marked with manufacturer's name or product #.
- .3 Trim, fittings: manufacture in accordance with CAN/CSA B125.
- .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 unless otherwise indicated.
- .7 Reference drawing schedule for configuration and type.

2.2 CARRIERS

- .1 Provide for all wall mounted plumbing fixtures.

2.3 ROUGHING-IN OF FIXTURES

- .1 Rough-in for equipment supplied by other to be complete with valved supplies, wastes and vents, capped and associated fitting piping & reducers.

2.4 PLUMBING FIXTURES

- .1 Reference fixture schedule on drawings.

2.5 ACCEPTABLE MATERIALS

- .1 Water Closets, Urinals, Lavatories, Sinks: American Standard, Crane, Kohler, Comtrac, Zurn, Toto, Moen.
- .2 Stainless Steel Sinks: Franke, Kindred, Architectural Metal Industries, Novanni.
- .3 Group Fountains: Bradley, Acorn.
- .4 Faucets: Delta Commercial, Crane, T&S Brass, Chicago Faucets, American Standard, Moen, Sloan, Zurn.
- .5 Tub & Shower: American Standards, Maxx, Crane, Longevity, Fiat.
- .6 Tub & Shower Trim: Delta Commercial, Crane, Powers Symmons, American Standard, Moen, Zurn.

- .7 Flush Valves: Delta Commercial, Crane, Sloan, Zurn, American Standard, Toto, Moen.
- .8 Emergency Fixtures: Haws, Bradley, Guardian.
- .9 Drinking Fountains: Elkay, Haws, Bradley.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as indicated on architectural elevations.
 - .3 Physically handicapped: to comply with most stringent of either OBC or CAN/CSA B651.

3.2 URINALS

- .1 Urinal waste pipe & fittings shall be DWV PVC equivalent to IPEX System 15 in accordance with specification Section 22 13 18 - Drainage Waste and Vent - Plastic. Extend plastic piping up to combined waste from adjacent lavatory or other plumbing fixtures allowing dilution of waste.

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified in this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates and sensors.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.
- .3 Checks:
 - .1 Water closets: flushing action.
 - .2 Aerators: operation, cleanliness.
 - .3 Vacuum breakers, backflow preventers: operation under all conditions.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Environmental Protection Agency (EPA):
 - .1 Building Air Quality - December 1991.
- .2 National Air Duct Cleaners Association (NADCA):
 - .1 NADCA, Mechanical Cleaning of Non-Porous Air Conveyance System Components.
 - .2 Understanding Microbial Contamination in HVAC Systems.
 - .3 Introduction to HVAC System Cleaning Services.
 - .4 NADCA Standard 05 - Requirements for the Installation of Service Openings in HVAC Systems.
- .3 National Fire Protection Association (NFPA).
- .4 North American Insulation Manufacturers Association (NAIMA):
 - .1 Cleaning Fibrous Glass Insulated Duct (Ductboard / Duct Board) Systems - Recommended Practices (AH122).
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA 1966, HVAC Duct Construction Standards - Metal and Flexible.
- .6 Underwriters' Laboratories (UL)
 - .1 UL 181, Factory-Made Air Ducts and Connectors.

1.3 QUALIFICATION

- .1 Membership: The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA) or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.
- .2 Certification: The HVAC system cleaning contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full-time basis or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
- .3 Supervisor Qualifications: A person certified as an ASCS by NADCA or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.
- .4 Experience: The HVAC system cleaning contractor shall submit records of experience in the field of HVAC system cleaning as requested by the owner. Bids shall only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

February 2026

- .5 Equipment, Materials and Labour: The HVAC system cleaning contractor shall possess and furnish all necessary equipment, materials, and labour to adequately perform the specified services.
 - .1 The contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification. For work performed in countries outside of the U.S.A., contractors should comply with applicable national safety codes and standards.
 - .2 The contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification
 - .3 Contractor shall submit to the owner all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.
- .6 Licensing: The HVAC system cleaning contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state, and local rules, regulations, and licensing requirements.

1.4 STANDARDS

- .1 NADCA Standards: The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).
 - .1 All terms in this specification shall have their meaning defined as stated in the NADCA Standards.
 - .2 NADCA Standards must be followed with no modifications or deviations being allowed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 SCOPE OF WORK

- .1 Scope: This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.
- .2 The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.
- .3 The HVAC system includes any interior surface of the air distribution systems for conditioned spaces which are new or modified as part of this contract. This includes the entire heating, air-conditioning, and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The air ducts (except ceiling plenums and mechanical room) to the air handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers, supply air ducts, fans, fan housing, fan blades, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components, reheat coils, induction units and associated ductwork.

February 2026

3.2 HVAC SYSTEM INSPECTIONS AND SITE PREPARATIONS

- .1 HVAC System Evaluation: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project.
 - .1 Damaged system components found during the inspection shall be documented and brought to the attention of the owner.
- .2 Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.

3.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

- .1 Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.
- .2 Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.
- .3 Controlling Odours: All reasonable measures shall be taken to control offensive odours and/or mist vapours during the cleaning process.
- .4 Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.
- .5 Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.
- .6 Service Openings: The contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.
 - .1 Contractor shall utilize the existing service openings already installed in the HVAC system where possible.
 - .2 Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.
 - .3 Closures must not significantly hinder, restrict, or alter the air-flow within the system.
 - .4 Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.
 - .5 Openings must not compromise the structural integrity of the system.
 - .6 Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.
 - .7 Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.

February 2026

- .8 Rigid fibre glass ductboard duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques which comply with UL 181 or UL Standard 181a are suitable for fibre glass duct system closures.
- .9 All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the owner in project report documents.
- .7 Ceiling sections (tile): The contractor may remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.
- .8 Air distribution devices (registers, grilles & diffusers): The contractor shall clean all air distribution devices.
- .9 Air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fans: The contractor shall insure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers, and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:
 - .1 Clean all air handling unit (AHU) internal surfaces, components and condensate collectors and drains.
 - .2 Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.
 - .3 Clean all coils and related components, including evaporator fins.
- .10 Duct Systems: Contractor shall:
 - .1 Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
 - .2 Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Testings (see NADCA Standards).

3.4 HEALTH AND SAFETY

- .1 Safety Standards: Cleaning contractors shall comply with all applicable federal, provincial, and local requirements for protecting the safety of the contractors' employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.
- .2 Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.
- .3 Disposal of Debris. All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state, and local requirements.

3.5 MECHANICAL CLEANING METHODOLOGY

- .1 Source Removal Cleaning Methods: the HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the contractor's responsibility to select Source Removal methods which will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of

February 2026

- methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.
- .1 All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment is assured.
 - .2 All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
 - .3 All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes, or regulations.
 - .4 All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.
- .2 Methods of Cleaning Fibrous Glass Insulated Components:
- .1 Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.
 - .2 Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).
- .3 Damaged Fibrous Glass Material
- .1 If there is any evidence of damage, deterioration, delamination, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.
 - .2 When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.
 - .3 Replacement material: In the event fibre glass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA.
 - .4 Replacement of damaged insulation is not covered by this specification.
- .4 Cleaning of coils
- .1 Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

February 2026

3.6 CLEANLINESS VERIFICATION

- .1 General: Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system.
- .2 Visual Inspection: the HVAC system shall be inspected visually to ensure that no visible contaminants are present.
 - .1 If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the owner reserves the right to further verify system cleanliness through gravimetric, or wipe testing analysis testing as specified herein.
 - .2 If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- .3 Gravimetric Analysis: At the discretion and expense of the owner, sections of the HVAC system may be tested for cleanliness using the NADCA Vacuum Test (gravimetric analysis) as specified in applicable NADCA Standards. Levels of debris collected shall be equal to or less than acceptable levels defined in applicable NADCA Standards.
 - .1 If gravimetric analysis determines that levels of debris are equal to or lower than those levels specified in applicable NADCA standards, the system shall be considered clean and shall have passed cleanliness verification.
 - .2 If gravimetric analysis determines that levels of debris exceed those specified in applicable NADCA standards, the system shall not be considered clean and those sections of the system which failed cleanliness verification shall be re-cleaned at the expense of the HVAC system cleaning contractor.
 - .3 Gravimetric analysis shall be performed by a qualified third party experienced in testing of this nature.
 - .4 Cleanliness verification shall be performed immediately after mechanical cleaning and before the HVAC system is restored to normal operation.
- .4 Verification of Coil Cleaning
 - .1 Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

3.7 POST-PROJECT REPORT

- .1 At the conclusion of the project, the Contractor shall provide a report to the owner indicating the following:
 - .1 Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.
 - .2 Areas of the system found to be damaged and/or in need of repair.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

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

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

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

3.2 CLEARANCES

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

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated or specified otherwise.
- .2 Install drain valve at low points in piping systems, at equipment at section isolating valves and at base of all risers.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS ¾ full port ball valves unless indicated otherwise, with hose end male thread, cap, and chain.

3.4 AUTOMATIC AIR VENTS

- .1 Install automatic air vents at high points of piping systems.
- .2 Install full port ball at each automatic air vent.
- .3 Air vents must have minimum connection of 13 mm (½").

3.5 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.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings to be jointed with polytetrafluoroethylene (PTFE) thread seal tape.
- .2 Protect openings against entry of foreign material.
- .3 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Weldolets sockolets Saddle type branch fittings may be used on mains if branch line is no larger than half the size of the main. Hole saw (or drill) and ream main so as to maintain full inside diameter of branch line prior to welding saddle. Provide isolation valves at each branch connection.
- .6 Install exposed piping, equipment, rectangular cleanouts, and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework so as to minimize furring space, maximize headroom, conserve space.
- .8 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.
- .9 Except where indicated, install so as 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 and specified.
- .14 Contractor shall carry a structural engineer to design and certify the support system for any piping distribution system exceeding 100 mm (4") or where piping is grouped such that the distributed weight exceeds the building structure limits. (Note: In steel building structure the piping supports shall never be supported by a single joist or off the bottom chord of the joist or truss.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors - to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance all round between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

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

3.9 FLUSHING OUT OF PIPING SYSTEMS

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.
- .3 Provide test results upon completion and retain written report on status after complete.

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Engineer 48 hours minimum prior to performance of pressure tests.
- .2 Pework: Fill system with water. Ensure all air is removed from system. Boost pressure to test pressure using water only. Pressurization with air or nitrogen is not allowed. Test to 1½ times normal operating pressure to a maximum of the piping systems working pressure including devices (i.e.: valves, fittings, accessories). Minimum test pressure to be 862 kPa (125 psi).
- .3 Maintain specified test pressure without loss for four (4) hours minimum. Temperature of system to remain constant during entire duration of test.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Bear costs for repairs or replacement, retesting, and making good. Engineer to determine whether repair or replacement is appropriate.
- .6 Insulate or conceal work only after review and approval of tests results by Engineer.

3.11 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Engineer.
- .2 Request written approval 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.
- .5 Cleaning & flushing of new piping to be done prior to making final connection to existing system. Refer to Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .6 Provide full size bypass as required to ensure cleaning of piping.

END OF SECTION

February 2026

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 GENERAL INSTRUCTIONS

- .1 Installation of piping must allow for expansion using offsets, loops, expansion joints, etc. to prevent undue strain.
- .2 Mains and risers with loops or offsets shall be securely anchored to structure to impart expansion towards loops or offsets. Provide bridge bearing quality rubber/neoprene isolation pads at all anchor and guide locations.
- .3 Provide pipe alignment guides to guide expanding pipe to move freely from anchor points toward expansion joints, offsets, etc.
- .4 All pipes specified on the drawing or specified in the table, subject to expansion and/or contraction shall be designed and supplied by a single party.
- .5 Any variance or noncompliance with these requirements shall be corrected by the contractor, in an approved manner, at no additional cost to the Owner.

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A307-21, Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
 - .2 ASTM A563/A563M-23, Specification for Carbon and Alloy Steel Nuts (Metric).
- .2 Manufacturer Recommendations.

1.4 PERFORMANCE REQUIREMENTS

- .1 Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

1.5 ACTION SUBMITTALS

- .1 Product Data: For each type of product indicated.
- .2 Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - .1 Design Calculations: Calculate requirements for thermal expansion and seismic restraint of piping systems and for selecting and designing expansion controls including compensators anchors and guides. Expansion shall be calculated based on a minimum ambient of 0°C.
 - .2 Design and prepare drawings and calculations for restraint of pipe expansion loops, joints, pipe alignment guides, and pipe anchors. Include seal and signature of Professional Engineer, certifying compliance with specifications.
 - .3 Submit maximum anchor reaction loads for review and approval to the Structural Engineer.

- .4 Anchor Details: Detail construction of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
- .5 Alignment Guide Details: Detail field assembly and attachment to building structure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- .1 All expansion joints shall be the product of a single manufacturer. Mason Industries, supplied by Tecoustics Ltd. (1-888-714-9596, www.tecoustics.com) products are the basis of these specifications. Products of other manufacturers will be considered provided samples and submittals comply with the specification.

2.2 MANUFACTURING STANDARDS

- .1 All flexible Vees and expansion joints shall be designed, manufactured, and tested in accordance with the latest applicable industry standards including the following:
 - .1 Standards of the Expansion Joint Manufacturers Association, 10th Edition, published 2015.
- .2 All equipment and material to be furnished and installed shall be in accordance with the requirements of the authorities having jurisdiction, and suitable for their intended use.

2.3 PRODUCTS

- .1 Flexible Vees shall consist of two braided stainless hoses joined by a 60° V fitting at the base and 120° return elbows. Vees shall be capable of plus or minus 1" motion in all planes. Flexible Vees in carbon steel lines shall have 304 stainless hose, and braid. Copper lines, bronze hose and braid. All flanged connectors shall have free floating flanges at each end to allow for the misalignment of piping flange holes and 360° rotation into optimum available space. Vees shall have a minimum burst pressure of four times their rated pressure at 70°F. Flexible Vees may be furnished with steel threaded nipples, weld ends, grooved ends, copper sweat ends, or raised face floating carbon steel flanges on both ends, as required. Fixed flanges are not acceptable. Flexible Vees shall be type VMN-1, VGN-1, VCPSB-1, or VFL-1 as manufactured by Mason Industries, Inc.
- .2 Externally pressurized expansion compensators and joints are manufactured with an externally pressurized 304 stainless steel bellows sealed within a steel housing. The housing is fixed, and pipe movement is taken up by extending or contracting the internal bellows. The internal, minimum two-ply bellows shall be protected from fluid or steam flow by an internal pipe sleeve to prevent wear. Clearances between the bellows and outer housing as well as the internal pipe shall be a minimum of 1/8". Bellows must not rub. Expansion compensators, 1/2" through 4" shall be rated for 2" of compression and 1/2" of extension, 200 psi at 70°F, and minimum burst pressure of 700 psi. Expansion joints 2" through 14" shall be rated for 4" of compression and 3/4" extension or 8" compression and 1-1/2" extension. Expansion Joints shall be rated for 225 psi at 70°F, and minimum burst pressure of 790 psi. Both expansion compensator and joint pressure ratings shall be lowered as needed at higher temperatures.
- .3 All carbon steel and stainless-steel expansion compensators and expansion joints shall be supplied with
 - .1 Permanent locking bolts to maintain length during installation and removal for servicing. Welded break off retaining tabs are not acceptable.
 - .2 Drain plug at each end of the housing.
 - .3 Lifting ring located at the centre of gravity (3" and larger).

- .4 Measurement scale to confirm starting position and operating movements.
- .5 Expansion compensators and joints may be furnished with steel threaded nipples, copper sweat ends, or one raised face fixed and one floating carbon steel flange, as required. Fixed flanges on both ends are not acceptable.
- .6 Compensators for Glycol shall be type EC, Expansion Joints type HEJ as manufactured by Mason Industries.
- .7 Pipe guides shall be manufactured with stainless steel wrapping the carbon steel sliding foot where it passes through horizontal U guides similarly lined to prevent corrosion. The base plate shall have multiple holes for bolting to beam flanges or flat surfaces. Bases may be welded into position in lieu of bolting. Height must be adjustable to accept different thicknesses of insulation up to 4". Guides shall be load rated based on P.Eng. supervised testing for bottom, overhead, side mounted or riser positioning to provide both load bearing and guiding capabilities. Sliding guides must allow 4" axial movements for pipe sizes 3/4" to 2-1/2", and 6" axial movement for pipe sizes 3" to 12". Should motion exceed these numbers, guides must be built to order. Dielectric spacers must be supplied for copper application.
- .8 Sliding Guide shall be type ASG as manufactured by Mason Industries, Inc.

2.4 ANCHORS

- .1 Description: The designer will select the anchor clamp as per the rated load and the pipe material.
 - .1 Steel Pipe: Steel riser clamp or custom attachment.
 - .2 Copper Pipe: copper riser clamp or steel riser clamp with dielectric spacer.
 - .3 Stainless Steel Pipe: Stainless Steel riser clamp, steel riser clamp or custom attachment.
 - .4 Bolts: as per ASTM A307.
 - .5 Nuts: as per ASTM A563.
- .2 Anchors and guides to accommodate specified thickness of insulation. Vapour barrier and jackets to remain uninterrupted.
- .3 Equivalent: Tecoustics, Anvil, Taylor, Myatt.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 All expansion devices shall be installed in accordance with the latest industry Standards, per the manufacturer's P.Eng. recommendations, and as indicated on the drawings.
- .1 Intermediate guides for carbon steel piping, schedule 40, shall not be spaced greater than as shown in Table 1 below:

Intermediate Guide Spacing for Carbon Steel Schedule 40 Piping			
Pipe Size (in)	Intermediate Guide Spacing (ft.)		
	Straight Solid Risers (No Expansion Joints)	Risers Having Up to 150 psi	Expansion Joints 151 - 300 psi
1	40	12	12
1.25	40	12	12
1.5	40	12	12
2	40	12	12
2.5	40	12	12
3	40	17	14

Intermediate Guide Spacing for Carbon Steel Schedule 40 Piping			
Pipe Size (in)	Intermediate Guide Spacing (ft.)		
	Straight Solid Risers (No Expansion Joints)	Risers Having Up to 150 psi	Expansion Joints 151 - 300 psi
4	50	25	19
5	50	30	23
6	50	37	27
8	50	45	33
10	60	58	42
12	72	69	48
14	85	71	51
16	85	78	56
18	85	85	61
20	120	91	65

- .2 Pipe guides shall be installed in accordance with the expansion joint manufacturers recommendations (i.e. 4 & 14 D). It is the mechanical contractor's responsibility to furnish any steel necessary to anchor guides at required interval. Installing guides only at ceiling or floor locations is unacceptable.
- .3 Pipe anchors shall be installed at the indicated locations and consistent with the contractor provided detail package. Pipes shall only be anchored when ambient temperature is greater than 0°C.

3.2 INSPECTION

- .1 Arrange and pay for expansion joint manufacturer's field representative to review anchors and guides around expansion joints.
- .2 Submit written report, prepared by field representative, confirming that expansion joints, anchors, and guides are installed in accordance with joint manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate on manufacturers catalogue literature the following:
 - .1 Thermometers.
 - .2 Pressure gauges.
 - .3 Ball valve.
 - .4 Syphons.
 - .5 Wells.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Thermometers and pressure gauges to operate at mid point of scale or range.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB-14.4.
 - .1 Acceptable Materials: Ashcroft, Taylor, Winters, Weiss, H.O. Terice.
- .2 Low light compatible solar powered display, durable NEMA-5 ABS case, 32 mm (1¼") UNF swivel nut, 19 mm (¾"), NPT with brass thermowell, 6 sec. read interval, -45°C (-50°F) to 160°C (320°F) range, accurate to 0.1°, switchable metric/imperial scale, vari-angle connection, ±1% accuracy, 4-20 mA output, 90 mm (3.5") stem, one (1) year warranty.
 - .1 Acceptable material: Winters Model TSD, Therice Model Solar Therm, Precision.

2.3 THERMOMETER WELLS

- .1 For copper pipe use copper or bronze. For steel pipe use brass.

2.4 PRESSURE GAUGES

- .1 Liquid filled, 112 mm, dial type: ASME B40.100, Grade 2A, having ½ of 1% accuracy over entire range, stem mounting.
 - .1 Acceptable Materials: Ashcroft, Taylor, Winters, Weiss, H.O. Trerice.
- .2 Provide ball valve and snubber for pulsating operation (pumps).

PART 3 EXECUTION

3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Install in wells on all piping. Provide heat conductive material for inside of well.
- .2 Install in locations as indicated and on inlet and outlet of:
 - .1 Coils.
 - .2 Boilers.
- .3 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in following locations:
 - .1 Suction and discharge of pumps.
 - .2 Inlet and outlet of coils.
 - .3 In other locations as indicated.
- .2 Pressure gauges are to be manifolded between inlet and outlet of device (pump, strainer, HX, etc.) unless otherwise indicated. Provide ball type isolation valve between pressure gauge and device.

3.4 PRESSURE & TEMPERATURE TEST STATIONS

- .1 Install in locations as indicated and on inlet and outlet of:
 - .1 Heating coils.
 - .2 Hydronic hot water radiation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B1.20.1, Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125 and 250.
 - .3 ASME B16.34, Valves - Flanged, Threaded and Welding End.
- .2 American Society for Testing and Materials (ASTM).
 - .1 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM B16/B16M- Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
 - .3 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS SP-67, Butterfly Valves.
 - .2 MSS SP-80, Bronze Gate Globe, Angle and Check Valves.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit data for all valves specified in this section.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

1.5 ACCEPTABLE MANUFACTURERS

- .1 Refer to Acceptable Products Table in Part 3 of this section.

PART 2 PRODUCTS

2.1 GENERAL

- .1 All valves of the same type to be from one manufacturer.
- .2 All valves to have CRN registration numbers.
- .3 All domestic water valves shall be lead-free versions of valves.
- .4 All valves shall be selected such that they will not be operated outside of their certified temperature & pressure range.

2.2 CHECK VALVES

- .1 NPS 2 and under, bronze swing type, bronze disc:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: with hex. shoulders.
 - .3 Body: Y-pattern with integral seat at 45°, screw-in cap with hex head.
 - .4 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .2 NPS 2½ and over, cast iron:
 - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin.
 - .1 Up to NPS 16: cast iron to ASTM A126 Class B.
 - .2 NPS 18 and over: cast iron to ASTM A126 Class C.
 - .2 Disc: Rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B62.
 - .2 NPS 8 and over: bronze-faced cast iron.
 - .3 Seat rings: renewable bronze to ASTM B62 screwed into body.
 - .4 Hinge pin, bushings: renewable bronze to ASTM B62.

2.3 BALL VALVES

- .1 NPS 4 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62 or brass to ASTM B16/B16M C36000.
 - .2 Stem: tamperproof ball drive.
 - .3 Stem packing nut: external to body.
 - .4 Ball and seat: replaceable chrome plated brass solid full port ball and Teflon seats.
 - .5 Stem seal: TFE with external packing nut.
 - .6 Operator: removable lever handle c/w handle extension to accommodate insulation thickness.

2.4 BUTTERFLY VALVES

- .1 NPS 2½ and over, lug body, dead end type:
 - .1 To MSS SP-67, Class 150, 1.4 Mpa WOG, cast iron or semi-steel body, ductile iron or bronze disc, stainless steel stem, replaceable EPDM liner and nylon coated ductile iron seat, locking handle.
 - .2 Operators:
 - .1 NPS 2½ to 5: locking type lever handle.
 - .2 NPS 6 and over: gear operator.

2.5 CIRCUIT BALANCING VALVES (CBV)

- .1 General:
 - .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports for connection to differential pressure meter. Provide port extensions to allow access without removing insulation.
- .2 Accuracy:
 - .1 Readout to be within $\pm 2\%$ of actual flow at design flow rate.
- .3 Pressure die-cast dezincification resistant copper alloy construction, Teflon disc, screw-in bonnet.
 - .1 Flow control: At least four 4 full turns of handwheel with digital handwheel and tamperproof concealed mechanical memory.
- .4 Insulation:
 - .1 Use prefabricated shipping packaging of 5.4 R polyurethane as insulation.
- .5 Drain connection:
 - .1 NPS $\frac{3}{4}$ valved and capped, suitable for hose socket.
 - .2 Incorporated into valve body or provided as separate item.
- .6 Size:
 - .1 Valve to be sized for a minimum pressure drop of 6 kPa (2 ft.) at design flow at mid range. Provide pipe reducers as required.

2.6 LUBRICATED PLUG VALVES

- .1 Valve:
 - .1 Body: cast iron to ASTM A126 Class B semi-steel.
 - .2 Plug: cylindrical or tapered, with regular Venturi or round pattern port - 90° from full open to fully closed.
 - .3 Number of ports: 2.
 - .4 Ends: with hexagon shoulders, ends screwed to ASME B1.20.1 up to NPS 3; Flanged to ASME B16.1 NPS 4 and over.
 - .5 Lubrication system, nickel-plated.
 - .6 Lubricant: to suit type, temperature, and pressure of contained fluid.
 - .7 Feeding system: lubricant forced into lubrication grooves between seating surfaces of plug and body to form positive seal, leakproof operation, and corrosion preventing film. Lubricant receptacle to hold additional lubricant. Lubricant screw for lubrication. Check valve to prevent reverse flow of lubricant. O-rings between body and plug.
- .2 Operator: manual - lever.
- .3 Accessories: lubricant gun.
- .4 Testing: to ASME B16.34.

PART 3 EXECUTION

3.1 INSTALLATION

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

- .2 Handwheel with chain operators are to be installed on all valves more than 3 metres above floor.
- .3 Remove internal parts before soldering or brazing.
- .4 Install all valves such that adequate clearance is provided to allow for obstruction free operation.
- .5 Install valves at all branch take-offs and to isolate each piece of equipment, and as indicated.
- .6 For all threaded valves provide one screwed union beside each valve to allow easy replacement of valve.
- .7 Install all valves as per manufacturer's recommendation.

3.2 ACCEPTABLE PRODUCTS

- .1 Domestic, Heating Water up to 200 psi.
 - .1 Ball Valve:
 - .1 NPS 4 & Under:
 - .1 Solder: Crane 9202 (up to 3"), Apollo 94A-200, Jenkins 202J (up to 3"), Toyo 5049A, Kitz 59
 - .2 Threaded: Crane 9201 (up to 4"), Apollo 94A-100, Jenkins 201J (up to 4"), Toyo 5044A, Victaulic 722, Kitz 58
 - .2 Butterfly Valve:
 - .1 NPS 2½ & Over:
 - .1 Flanged: Crane 44BXZ, Apollo LD141, Jenkins 2232EJ, Toyo 928 BESL/G, Kitz 6122 EL/G
 - .2 Grooved (steel): Victaulic Vic-300, Shurjoint SJT300
 - .3 Grooved (copper): Victaulic Vic-608, Shurjoint SJC300
 - .3 Check Valve:
 - .1 NPS 2 & Under:
 - .1 Solder: Crane 1342, Apollo 161S, Jenkins 4093J, Toyo 237, Kitz 23
 - .2 Threaded: Crane 37, Apollo 161T, Jenkins 4037, Toyo 236, Kitz 22
 - .2 NPS 2½ & Over:
 - .1 Flanged: Crane 373, Apollo 910F, Jenkins 587J, Toyo 435, Kitz 78
 - .2 Grooved: Victaulic 716, Shurjoint SJT900
 - .4 Balancing Valve:
 - .1 NPS 2 & Under:
 - .1 Solder: Tour & Anderson STAS, Apollo 58A, Armstrong CBV-S, Bell & Gossett CB-S, Redwhite 9519
 - .2 Threaded: Tour & Anderson STAD, Apollo 58A, Armstrong CBV-T, Bell & Gossett CB, Redwhite 9517
- .2 Natural Gas.
 - .1 Ball Valve:
 - .1 NPS 2" & Under (Indoor):
 - .1 Threaded: Crane 9201, Apollo 94A, Jenkins 201J, Toyo 5044A, Kitz 58

.2 Lubricated Plug:

.1 NPS 2-1/2" & Over:

.1 Flanged: Newman Milliken 171M, Jenkins 150 SCTAM-FS

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 ASTM A563/A563M, Specification for Carbon and Alloy Steel Nuts (Metric).
 - .3 ASTM D1929 Standard Test Method for Determining Ignition Temperature of Plastics.
 - .4 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .5 ASTM E96/E96M, Standard Test Methods for Water Vapour Transmission of Materials.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design, Selection, Manufacture, Application, and Installation.

1.3 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 SP-58.
- .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 all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.4 DESIGN FOR SEISMIC EVENTS

- .1 Design supports, platforms, hangers, racks to withstand seismic events as specified Section 20 05 49.01 - Seismic Restraint Systems (SRS) for Mechanical Systems.

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements (SRS) for Mechanical Systems.
- .2 Submit shop drawings and product data for following items:
 - .1 All bases, hangers and supports.

- .2 Connections to equipment & structure.
- .3 Structural assemblies.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.
 - .1 Cold piping NPS 2 maximums: Malleable iron C-clamp with hardened steel cup point setscrew, locknut, and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed.
 - .2 Cold piping NPS 2½ or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS SP-58.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
 - .1 Cold piping NPS 2 maximums: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP-58.
 - .2 Cold piping NPS 2½ or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Manufacturer assemblies:
 - .1 Sway braces for seismic restraint systems: to Section 20 05 49.01 - Seismic Restraint Systems (SRS) for Mechanical Systems.
- .5 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .6 Pipe attachments: material to MSS SP-58.
 - .1 Attachments for steel piping: carbon steel black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.

- .4 Oversize pipe hangers and supports.
- .7 Adjustable clevis: material to MSS SP-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis. Ensure "U" has hole in bottom for riveting to insulation shields.
- .8 Yoke style pipe roll: carbon steel yoke, rod, and nuts with cast iron roll, to MSS SP-58.
- .9 U-bolts: carbon steel to MSS SP-58 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper, glass, brass, or aluminum pipework: black, with formed portion epoxy coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-58, Type 43.
 - .1 Finish: Hot dipped galvanized steel.
 - .2 Acceptable material: Tolco or approved equal.

2.3 INSULATED PIPE SADDLES

- .1 Insulated saddles shall be installed by the mechanical contractor when setting pipe elevation at all pipe support locations on insulated systems operating between -290°F and +250°F including:
 - .1 Domestic cold water, chilled water, condenser water
 - .2 Domestic hot water, heating water and low-pressure steam
- .2 Composition includes:
 - .1 Rigid phenolic foam insulation that meets ASTM E84 (25/50 flame spread/smoke developed requirement) with density of:
 - .1 3.75 PCF (0.17 Btu-in./hr.-ft.²-°F @ 75°F mean) for pipe sizes up to 10" IPS
 - .2 Zero perm rated (ASTM E96), abuse-resistant vapour barrier jacket with 1½" wide longitudinal self-sealing acrylic tape closure system.
 - .3 Pipe insulation protection shield, manufactured from carbon steel with a G90 galvanized finish, centred and adhered to bottom with a minimum of 1.5" jacketed insulation extending from each side to allow proper circumferential closure at butt joints with 3" wide zero perm tape. Shields shall be 20 gauge thick up to 3½" piping, 18 gauge for piping from 4" to 10" diameter.
 - .4 Acceptable Material: Multiglass M-Saddle, Buckaroos Cooldry or approved equivalent.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping: 64 kg/m³ density insulation plus insulation protection shield to: MSS SP-58, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping: curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP-58.

2.5 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations and a stamped shop drawing for a review.

2.6 ROOF MOUNTED SUPPORTS

- .1 Pressure treated lumber supports are only acceptable when roofed in/covered by general trades. Exposed applications are not acceptable.

- .2 Bases: Injection molded high density polypropylene with UV-inhibitors or recycled rubber conforming to the following:
 - .1 Moisture content: Negligible.
 - .2 Shrinkage/swelling due to moisture: Negligible.
 - .3 Density: 894 kg/m³ (55.8 lbs./ft.³).
 - .4 Insect resistance: No known insect damage potential.
 - .5 Chemical resistance (oil, brake fluid, gasoline, diesel, antifreeze, battery acid, sulfuric acid: no visual or physical change apparent.
 - .6 Flammability: No ignition after 10 minutes, 25 kW/m, when tested in accordance with ASTM D1929.
 - .7 Sized as required by loading conditions and as indicated on the drawings.
 - .8 Shop fabricated with inserts for square tubing or threaded rods as required.
 - .9 Colour: Integral black colour as molded.
- .3 Pipe Supports and Hangers: Conform to MSS SP-58 and as follows:
 - .1 Fabricate of carbon steel where framing is carbon steel; fabricate of stainless steel where framing is stainless steel; finished same as framing.
 - .2 Sizes 2½ in. (63 mm) and smaller: Single roller supports for piping subject to expansion and contraction; 3-sided channels and pipe clamps.
 - .3 Sizes 3 in. (76 mm) and larger: Rollers, clevis hangers, or band hangers, to allow for expansion and contraction without movement of the bases or framing.
- .4 Accessories: Clamps, bolts, nuts, washers, and other devices as required for a complete system:
 - .1 Carbon steel: Hot-dip galvanized in accordance with ASTM A153/A153M.
 - .2 Stainless steel: mill finish.
- .5 Acceptable material: Portable Pipe Hangers (PHP), Big Foot Systems, Mifab, Miro Industries, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions and recommendations.
- .2 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .3 When attaching to open web steel joists provide additional hangers for pipes with diameters of 75 mm or greater in order to reduce the magnitude of the concentrated load and spread the load to the joists equally. In these cases, the allowable spacing of hangers for pipes permitted under ASME/MSS SP-58 will be reduced and additional hangers will be required as directed by steel fabricator and/or structural engineer.
- .4 Locate hangers at the top of open web steel joists where the horizontal and diagonal members meet at a joint.
- .5 All installations must be in conjunction with Section 20 05 49.01 - Seismic Restraint System (SRS) for Mechanical Systems.

3.2 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Manufacturer's recommendations, Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas & fuel piping: to applicable code.
- .4 Copper piping: up to NPS 1½: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .6 Within 300 mm of each elbow.

Maximum Pipe Size NPS	Maximum Spacing Steel	Maximum Spacing Copper	Maximum Spacing XFR
up to 1¼	2.1 m	1.8 m	1.6 m
1½	2.7 m	2.4 m	1.6 m
2	3.0 m	2.7 m	1.8 m
2½	3.6 m	3.0 m	1.8 m

- .7 Pipework greater than NPS 12: to MSS SP-58.

3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Plumbing contractor shall install insulated pipe saddles at all hanger locations. Insulated saddle jackets to be sealed, ready for integration into insulation system.

3.4 HORIZONTAL MOVEMENT

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

3.5 FINAL ADJUSTMENTS

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 C-clamps: Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .3 Beam clamps: Hammer jaw firmly against underside of beam.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB 24.3, Identification of Piping Systems.
- .2 Canadian Standards Association (CSA).
 - .1 CSA B149.1, Natural Gas and Propane Installation Code.
 - .2 CSA Z7396.1, Medical Gas Pipeline Systems - Part 1: Pipelines for Medical Gases, Medical Vacuum, Medical Support Gases, and Anaesthetic Gas Scavenging Systems.
- .3 National Fire Protection Association
 - .1 NFPA (Fire) 13, Installation of Sprinkler Systems.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Product data to include paint colour chips, all other products specified in this section.

PART 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be 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.
- .2 Construction:
 - .1 1/8" thick laminated plastic, matte finish, with square corners, letters accurately, aligned, and machine engraved into core.

February 2026

.3 Sizes:

.1 Conform to following table:

Size #	Height Sizes (mm)	No. of Lines (mm)	Height No. of Letters
1	40	1	20
2	75	1	50

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

.4 Locations:

.1 Terminal cabinets, control panels: Use size #1.

.2 Equipment in Mechanical Rooms: Use size #2.

2.3 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: To CSA B149.1.

.2 Sprinklers: To NFPA (Fire) 13.

.3 Medical Gas: To CSA Z7396.1.

2.4 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking; legend; direction of flow by arrows. To CAN/CGSB-24.3 except where specified otherwise.

.2 Legend:

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

.3 Arrows showing direction of flow:

.1 Continuous wrap full diameter of pipe at each end of pipe identification markers.

.4 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

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

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

.1 Pipes and tubing $\frac{3}{4}$ " and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 300°F and intermittent temperature of 400°F.

.6 Colours and Legends:

.1 Where not listed, obtain direction from Engineer.

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

Background colour:	Legend, arrows:
Yellow	Black
Green	White
Red	White

February 2026

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold-water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN.
Plumbing vent	Green	SAN. VENT
Natural gas	to Codes	
Fire protection	Red	FIRE PROT. WTR

2.5 IDENTIFICATION DUCTWORK SYSTEMS

- .1 150 mm (6") high stencilled letters and directional arrows 150 mm (6") long x 50 mm (2") high.
- .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.6 MECHANICAL EQUIPMENT, VALVES CONTROLLERS, PUMPS, BOILERS, FAN COIL, ETC.

- .1 Lamicoid tag with 13 mm (½") 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 Brass tags with 13 mm (½") stamped identification data filled with black paint.
- .4 Brass tags to be stamped with system identification and valve number system as outlined below:

SYSTEM	BRASS TAG STAMP
Domestic Cold Water	DC-1,2, ...
Domestic Hot Water	DH-1,2, ...
Storm	ST-1,2, ...
Sanitary	SA-1,2, ...
Heating Water	HW-1,2, ...
Glycol Heating	GH-1,2, ...
Natural Gas	NG-1,2, ...
Refrigerant	Re-1,2, ...

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 to be in English.

February 2026

PART 3 EXECUTION

3.1 TIMING

- .1 Provide identification only after all painting specified in Architectural section is complete re: Interior Painting has been completed.

3.2 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.

3.3 NAMEPLATES

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

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at least one is visible from any one viewpoint in operating areas and walking aisles. At not more than 17 m (55 ft.) 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, other confined spaces, at entry and exit points, and at each access opening.
- .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, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
- .10 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.
- .11 At branch take-offs on both main and branch.

February 2026

3.5 MECHANICAL EQUIPMENT, VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass were directed by Engineer. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.
- .4 Where equipment is above accessible ceiling, provide coloured self-adhesive 13 mmØ dots to identify location of equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Associated Air Balance Council/Canadian Associated Air Balance Council (AABC/CAABC).
- .2 Government of Canada - MD 15128, Laboratory Fume Hoods.
- .3 National Balancing Council (NBC).

1.3 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.

1.4 QUALIFICATIONS OF TAB PERSONNEL

- .1 Provide documentation confirming qualifications, successful experience.

1.5 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 so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.6 EXCEPTIONS

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

1.7 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, were interlocked with other systems, in unison with those systems.
- .3 Coordinate TAB with controls, mechanical and electrical contractors.

1.8 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Engineer adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Engineer in writing all proposed procedures which vary from standard.

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

1.9 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Divisions 20, 21, 22, 23 & 25.

1.10 OPERATION OF SYSTEMS DURING TAB

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

1.11 START OF TAB

- .1 Notify Engineer 10 days prior to start of TAB.
- .2 Start TAB only when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, caulking.
 - .3 All pressure, leakage, other tests specified elsewhere in Divisions 20, 21, 22, 23 & 25.
 - .4 All provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal, and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 All 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.

February 2026

- .4 Combustion air:
 - .1 With all heating appliances, within the boiler room, operating on high fire, measure:
 - .1 Combustion air volume entering boiler room from outside.
 - .2 Differential pressure to:
 - .1 Outside
 - .2 Adjacent areas of the building.
 - .3 With all heating appliances on high fire, check each natural draft appliance diverter for any back draft.

1.12 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 All other HVAC systems: +5%, -5%.
 - .2 Hydronic systems: $\pm 10\%$.
 - .3 Laboratory HVAC systems: +10%, -0%.

1.13 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within $\pm 2\%$ of actual values.

1.14 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .2 Calibrate within 3 months of TAB.

1.15 SUBMITTALS

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

1.16 TAB REPORT

- .1 Format to be in accordance with AABC/CAABC.
- .2 TAB report to show all results in SI units or Imperial (IP), to match drawings and specifications, and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit pdf electronic copy of TAB Report to Engineer for verification and approval.

1.17 VERIFICATION

- .1 All reported results subject to verification by Engineer.
- .2 Provide manpower and instrumentation to verify up to 30% of all reported results.
- .3 Number and location of verified results to be at discretion of Engineer.
- .4 Bear costs to repeat TAB as required to satisfaction of Engineer.

- .5 At request of commissioning agent, provide manpower and instrumentation to verify an additional 30% of all reported results.
- .6 At the request of the Engineer, provide manpower and instrumentation to adjust airflows & rooftop units to revised air values as a result of noise issue or other commissioning problems.

1.18 SETTINGS

- .1 After TAB is completed to satisfaction of Engineer, replace drive guards, close all access doors, lock all devices in set positions and ensure sensors are at required settings.
- .2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.19 COMPLETION OF TAB

- .1 TAB to be considered complete only when final TAB Report received and approved by Engineer.

1.20 SYSTEMS

- .1 Quality assurance: Perform TAB of complete mechanical systems over entire operating range in accordance with most stringent conditions of AABC/CAABC & NBC.
- .2 Air Systems: Include both specified and measured data.
 - .1 Air Handling Equipment:
 - .1 Maximum air flow volume.
 - .2 Fan total pressure.
 - .3 Motor volts, amps, and power.
 - .4 Minimum outside air volume.
 - .2 Duct Air Quantities - Mains and Branches:
 - .1 Duct size.
 - .2 Number of pressure/velocity readings per traverse.
 - .3 Sum of velocity measurements.
 - .4 Average velocity.
 - .5 Duct air flow volume.
 - .6 Barometric pressure and duct air temperature.
 - .3 Air Outlets:
 - .1 Outlet location and designation.
 - .2 Manufacturers catalogue identification and type.
 - .3 Air outlet flow factors. Use 1.0 when flow hood is used.
 - .4 Air flow volumes.
 - .5 Deflector vane or diffuser cone settings.
- .3 Hydronic Systems: Include both specified and measured data.
 - .1 Pumps:
 - .1 Discharge and suction pressures, at design flow and no flow.
 - .2 Fluid flow rate. Calculate from pump curves if metering not provided.

- .3 Motor volts, amps, power.
- .4 RPM.
- .2 Piping Systems:
 - .1 Supply and return of each primary loop.
 - .2 Supply and return of each secondary loop.
 - .3 Make-up water inlet.
 - .4 Domestic hot water recirculation.
- .3 Heating Equipment:
 - .1 Equipment type, location, and designation.
 - .2 Fluid used. Identify fluid used; water, % water/ethylene glycol mixes, steam, etc.
 - .3 Fluid flow rate.
 - .4 Fluid entering and leaving temperatures and pressures
- .4 Air Heating and Cooling Coils:
 - .1 Coil type and identification, location, and designation.
 - .2 Entering and leaving air dry and wet bulb temperatures.
 - .3 Air flow volume.
 - .4 Fluid flow rate.
 - .5 Fluid entering and leaving temperatures and pressures.
- .5 Unit and Cabinet Heater:
 - .1 Start unit and check for noise or vibration.
 - .2 Check unit performance for each fan speed:
 - .1 Air flow and temperature rise.

1.21 PLUMBING SYSTEMS

- .1 Inlet and outlet temperature of each heater or tank.
- .2 Main supply piping main branch piping.
- .3 Flush valves adjusted to suit project pressure conditions.

1.22 OTHER SYSTEMS

- .1 Plumbing systems:
 - .1 Controlled flow roof drain systems: adjust weirs to suit actual roof conditions, slopes, areas drained.
- .2 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.
- .3 Zone pressure differences:
 - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.

February 2026

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 BALANCING AND ADJUSTING PREPARATION

- .1 Perform testing, adjusting and balancing work after equipment and systems starting procedures have been properly completed.
- .2 Perform balancing during heating and cooling season of first year of operation, and at times when directed by Engineer, to ensure proper settings of controls under both summer and winter peak load conditions.
- .3 Vary load to verify operation of system under partial load conditions. Test start-up, shut-down, emergency conditions, safety controls operation and automatic and manual resets and interlocks.
- .4 Cap all instrument test ports. Obtain caps from sheet metal contractor and install.
- .5 For all adjustable diffusers/grilles: Adjust air pattern to ensure proper air distribution and to avoid dumping. Air velocity shall not exceed 0.25 m/s (50 fpm) in the occupied zone (or as directed by Engineer).
- .6 Allow for ultrasonic flow measurement where hydronic flow measurements are required, but circuit balancing valves are not provided.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM B209/B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C335/C335M, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C449, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.10, Mineral Fibre Board Thermal Insulation.
 - .2 CAN/CGSB 51.11, Mineral Fibre Thermal Insulation Blanket.
 - .3 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Manufacturer's Trade Associations: Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .4 Underwriters Laboratories (UL)
 - .1 UL 723, Tests for Surface Burning Characteristics of Building Materials.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN-ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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" - will mean "not concealed" as defined herein.
 - .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 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.

- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section and have at least 5 years' successful experience in this size and type of project, qualified to standards.

1.6 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.
- .3 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB-51.10, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to CAN/CGSB-51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/CGSB-51.11.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/CGSB-51.11.
 - .4 Density: 24 kg/m³.

2.3 JACKETS

- .1 Canvas: 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum:
 - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Stucco embossed.
 - .4 Jacket banding and mechanical seals: 19 mm (¾") wide, 0.5 mm thick stainless steel.

- .4 Acrylic Adhesive (Indoor Applications only):
 - .1 Thickness: 0.18 mm.
 - .2 Finish: Stucco embossed.
 - .3 Peel Adhesion: 18N/25 mm (65 oz./in.)
 - .4 Puncture: 130N (30 lbs.).
 - .5 UL 723 listed (10/20 flame/smoke rating).
 - .6 Acceptable material: VentureClad 1577CW.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive: Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .5 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.
- .6 Contact adhesive: quick-setting
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 19 mm (¾") wide, 0.5 mm thick stainless steel.
- .10 Facing: 25 mm (1") galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .11 Fasteners: 2 mm diameter pins with 38 mm (1½") diameter clips, length to suit thickness of insulation.

PART 3 EXECUTION

3.1 PRE- INSTALLATION REQUIREMENTS

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

3.2 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 thickness exceeds 75 mm (3").
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Bases, Hangers and Supports
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

- .6 Fasteners: At 300 mm (12") oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness mm (in.)
Rectangular cold and dual temperature supply & return air ducts in exposed areas including silencers (mechanical room, open ceiling, etc.)	C-1	yes	25 (1")
Cold and dual temperature supply air ducts in concealed ceiling space and all-round cold ducts including silencers	C-2	yes	25 (1")
Outside air ducts to mixing plenum	C-1	yes	50 (2")
Supply and return ducts exposed in space being served	none		
Exhaust ducts within 3 m from roof/ exterior wall penetration	C-1	yes	50 (2")
Ductwork Outdoors	C-1*	yes	75 (3")
Acoustically lined ductwork inside building	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: Provide aluminum jacket on ductwork within transition curbs.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM) (latest edition).
 - .1 ASTM B209/B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C335/C335M, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C449, Standard Specification for Mineral Fibre -Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.2, Thermal Insulation, Calcium Silicate, for Piping, Machinery and Boilers.
 - .2 CAN/CGSB 51.9, Mineral Fibre Thermal Insulation for Piping and Round Ducting.
 - .3 CAN/CGSB 51.11 , Mineral Fibre Thermal Insulation Blanket.
 - .4 CAN/CGSB-51.12, Cement, Thermal Insulating and Finishing.
 - .5 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Manufacturer's Trade Associations (latest edition).
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN-ULC S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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 defined herein.
- .2 TIAC Codes:
 - .1 CPF: Code Piping Finish.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves, and jointing recommendations.

1.5 MANUFACTURER'S INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.6 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section and have at least 5 years' successful experience in this size and type of project, qualified to standards.

1.7 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.
- .3 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/CGSB-51.9.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/CGSB-51.9.
- .4 TIAC Code C-2: Mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/CGSB-51.11.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/CGSB-51.11.
 - .4 Density: 24 kg/m³.
- .5 TIAC Code A-6: vapour retarder flexible unicellular tubular elastomer.
 - .1 Jacket: to CGSB 51-GP-52
 - .2 Maximum "k" factor.
 - .3 Certified by manufacturer free of potential stress corrosion cracking corrodents.

- .6 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: to CAN/CGSB-51.2.
 - .2 Maximum "k" factor: to CAN/CGSB-51.2.
 - .3 Design to permit periodic removal and re-installation.

2.3 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.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 To CAN/CGSB-51.12.
 - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C449.

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 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.
 - .3 Random samples to be taken during installation c/w date & time on sample.
- .2 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: embossed.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .3 PVC:
 - .1 Ontario Building Code compliant for 25/50 flame spread and smoke developed.
 - .2 Minimum thickness 0.38 mm.

- .3 Colour white unless otherwise specified.
- .4 Non yellowing UV stabilized.
- .5 Minimum service temperatures: -20°C.
- .6 Maximum service temperature: 65°C.
- .7 Moisture vapour transmission: 0.02 perm.
- .8 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.

PART 3 EXECUTION

3.1 PRE- INSULATION REQUIREMENT

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

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 All roof drain bodies shall be thermally insulated with 50 mm thick mineral fibre blanket faced with factory applied vapour retarder jacket.
- .5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
 - .2 Saddles to have ridges to limit movement while in hanger.
 - .3 To be edge flared to prevent cutting/damage to insulation coverage.
- .6 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulated saddles have not been provided.
 - .2 Butt insulation up to insulated saddle and seal to saddle jacket as per TIAC code requirement.

3.3 INSTALLATION OF ELASTOMERIC INSULATION

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

3.4 PIPING INSULATION SCHEDULES

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

- .2 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm oc.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .3 TIAC Code: A-6.
 - .1 Insulation securements: Bands.
 - .2 Seals: lap seal adhesive, lagging adhesive.
- .4 TIAC Code: C-2.
 - .1 Insulation securements: combination of wire and bands.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: A-2.
 - .1 Insulation securements: stainless steel bands.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-H.
- .6 Thickness of insulation to be as listed in following table:

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)	
			½ to 1¼	1½ to 3
Hot Water Heating	61 - 93	A-3	38	50
Domestic Hot Water		A-3	25	38
Domestic Hot Water Recirc		A-3	25	38
Domestic Cold Water		A-3	25	25
Storm Piping		A-3	25	25
Storm Roof Drains		C-2	50	50

- .7 Finishes:
 - .1 Piping & fittings: PVC.
 - .2 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .3 Finish attachments: Stainless steel bands at 150 mm oc. Seals: wing or closed.
 - .4 Installation: To appropriate TIAC code CPF/1 through CPF/5.
- .8 Storm piping & fittings to be insulated from all roof drain bodies to storm piping at grade level.
- .9 Domestic hot & cold and recirc piping shall be completely thermally insulated to fixtures, except exposed supply assembly at fixtures.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

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

1.3 HYDRONIC SYSTEMS PERFORMANCE VERIFICATION

- .1 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 in relevant technical sections, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.
 - .2 Heat exchanger operation.
 - .3 Pressure bypass open/closed.
 - .4 Control pressure failure.
 - .5 Maximum heating demand.
 - .6 Maximum cooling demand.
 - .7 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.4 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Divisions 20, 21, 22, 23 & 25.
- .2 Verification of controls, detection devices, alarm devices is specified Division 26.
- .3 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.5 SANITARY AND STORM DRAINAGE SYSTEMS

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

February 2026

- .6 Roof drains:
 - .1 Refer to Section 22 42 01 - Plumbing Specialties and Accessories.
 - .2 Remove caps as required.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

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 GENERAL

- .1 Provide all material & labour associated with flushing and cleaning of system including full size bypass and associated accessories.

3.2 CLEANING HYDRONIC AND STEAM SYSTEMS

- .1 Timing: Systems to be operational, hydrostatically tested and with safety devices functional before cleaning is carried out.
- .2 Cleaning Agency: Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations to be 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 to be used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems
 - .1 Systems to be free from construction debris, dirt, and other foreign material.
 - .2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.
 - .3 Strainers to be clean prior to initial fill.
 - .4 Install temporary filters on pumps not equipped with permanent filters.

February 2026

- .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning. 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 meter to record volume of water in system to $\pm 0.5\%$.
 - .4 Add chemicals under direct supervision of chemical treatment supplier.
 - .5 Closed loop systems: circulate system cleaner at 60°C for at least 36 h. Drain as quickly as possible. Refill with water plus inhibitors. Test concentrations and adjust to recommended levels.
 - .6 Flush velocity in system mains and branches to be adequate so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
 - .7 Add chemical solution to system.
 - .8 Establish circulation, raise temperature slowly to maximum design or 82°C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and expansion tank level, set pressure controls.
 - .2 Ensure all air is removed.
 - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
 - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
 - .5 Clean out strainers repeatedly until system is clean.
 - .6 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and all other noises.
 - .7 Bring system up to design temperature and pressure slowly over a 24 hour period.
 - .8 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing (TAB).
 - .9 Adjust pipe supports, hangers, springs, as necessary.
 - .10 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
 - .11 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
 - .12 Re-tighten all bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
 - .13 Check operation of drain valves.

- .14 Adjust valve stem packings as systems settle down.
- .15 Fully open all balancing valves (except those that are factory-set).
- .16 Check operation of over-temperature protection devices on circulating pumps.
- .17 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.5, Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24, Metric/Inch.
 - .2 ASME B16.20, Metallic Gaskets for Pipe Flanges.
 - .3 ASME B16.21, Non-metallic Flat Gaskets for Pipe Flanges.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A47/A47M Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B137:23 SERIES PACKAGE, Thermoplastic Pressure Piping Standards Package.
 - .2 CSA B149.1, Natural Gas and Propane Installation Code.
 - .3 CSA B149.2, Propane Storage and Handling Code.
 - .4 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
 - .5 CSA W47.1, Certification of companies for fusion welding of steel

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 PIPE

- .1 Above ground steel pipe: to ASTM A53/A53M, Grade B Schedule 40, Electric-resistance welded (non-seamless) as follows:
 - .1 NPS ½ to 2, screwed, press fit, socket welded where concealed within the building.
 - .2 NPS 2½ and over, welded.
- .2 Below grade polyethylene pipe: to CSA B137.4 and CSA B149.1 c/w coated aluminum AWG 14 tracer wire extended above grade at beginning and end. Magnetic tape is not acceptable.
 - .1 Acceptable material: Performance Pipe - Driscopex 6500-PE2406.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: to ASME B16.21 or ASME B16.20.

2.3 FITTINGS

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

2.4 VALVES

- .1 Provincial Code approved, lubricated plug or ball type as per specification Section 23 05 23 - Valves.

2.5 PRESSURE REDUCING VALVE

- .1 PRV: Provide gas service regulator self-contained to reduce pressure to design capacity.
- .2 Spring loaded self-operated regulator, molded diaphragm, 6:1 lever ratio, c/w internal separate-safety relief valve.
- .3 Extend safety relief valve outlet to atmosphere; terminate in safe location c/w with elbow with screen.
- .4 Reference equipment schedules for performance & capacities.
- .5 Relief valve shall be sized to protect the downstream equipment in accordance with the equipment manufacturer's recommendations.
- .6 Acceptable material: Norgas/Itron, Sensus, Maxitrol, Fisher.

2.6 ROOF PIPE SUPPORTS

- .1 Non seismic, surface mounted 300 x 300 x 65 mm high wide body 100% recycled rubber base, UV resistant, pipe supports with 14 gauge galvanized steel strut & strut pipe clamp, two (2) 13 mm dia. electro zinc plated all threaded rod risers (200-400 mm high rods). Maximum load: 364 kg (800 lbs.). Provide tape between pipe & strut clamps. Acceptable material: Mifab C-Port #CEW.
- .2 Seismic supports, as per CSA B149.1 and as per Section 20 05 49.01 - Seismic Restraint Systems (SRS) for Mechanical Systems.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with ASME BPVC.IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections recommended by equipment manufacturer.

- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer installation instruction for operation, servicing, and maintenance without disruption of operation of any other equipment/system.
- .4 All equipment, venting and gas assembly work shall be installed & certified by a provincially certified gas fitter I Level mechanic.

3.2 PIPING

- .1 Install in accordance with applicable Provincial/Territorial Codes.
- .2 Install in accordance with CSA B149.1 and CSA B149.2.
- .3 Assemble piping using fittings manufactured to ASME standards.
- .4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .5 Slope piping down in direction of flow to low points as per Gas Utilization Code.
- .6 Install drip points:
 - .1 At all low points in piping system.
 - .2 At each connection to equipment.
- .7 Use eccentric reducers at pipe size change installed to provide positive drainage.
- .8 Provide clearance for access and for maintenance.
- .9 Ream pipes, clean scale, and dirt, inside and out.
- .10 Install piping to minimize pipe dismantling for equipment removal.
- .11 Relief valve piping shall terminate outdoors with clearances to openings, intakes, etc. in accordance with CSA B149.1
- .12 Press fittings shall be selected and installed in accordance with manufacturer's installation instructions, using manufacturer's recommended tools. Installers shall be trained by manufacturers.
- .13 Paint all piping in damp/corrosive environments (such as outdoors, within parking/repair garages, etc.) with corrosion resistant, yellow paint.

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Engineer.
- .2 Install valves at all branch take-offs to isolate each piece of equipment, and as indicated.
- .3 Vent reliefs at pressure regulating valves to outdoors and minimum 3 metres for intakes.
- .4 All valves on exterior of building or where prone to vandalism, install lubricated plug type valve, regardless of size.

3.4 TESTING

- .1 Test system in accordance with CSA B149.1 and CSA B149.2.
- .2 On new natural gas service, Enbridge gas or authority having jurisdiction shall conduct a field review of all new equipment appliance venting & piping systems and submit a certificate of acceptance from a Certified G-1 Gas Fitter.
- .3 On existing natural gas services, contractor shall commission TSSA to provide a field inspection of the work. Contractor shall pay all fees & costs and make application to TSSA fuel branch division. Contractor shall submit Inspection Report to Owner for record. Any orders or non-

compliance relating to existing conditions, not relating to the proposed scope of work shall be deemed additional to the contract.

- .4 Owner at their own discretion shall engage a Certified G-1 Gas Fitter to review the installation and the contractor shall be responsible for any & all remedial work to their installation should it be deemed deficient or incomplete.

3.5 PURGING

- .1 Purge after pressure test in accordance with CSA B149.1 and CSA B149.2.
- .2 Following testing, purge air from all natural gas lines to all new and existing equipment including boilers, water heaters, rooftop units, etc. Start-up all new and existing equipment to ensure operational.

3.6 PRE-START-UP INSPECTIONS

- .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
- .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.7 CLEANING AND START-UP

- .1 In accordance with requirements of CSA B149.1 & CSA B149.2.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - .1 ANSI/AWWA C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- .2 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300
 - .2 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
 - .3 ASME B16.9, Factory-Made Wrought Buttwelding Fittings
- .3 ASTM International (ASTM):
 - .1 ASTM B16/B16M, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
 - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
 - .3 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings
- .4 CSA Group (CSA):
- .5 CSA Group (CSA):
 - .1 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding
- .6 Manufacturer's Standardization of the Valve and Fittings Industry (MSS):
 - .1 MSS-SP-67, Butterfly Valves
 - .2 MSS-SP-71, Grey Iron Swing Check Valves Flanged and Threaded Ends

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.

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.

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 or lead-free pipe dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Orifice flanges: slip-on raised face, 2100 kPa.
- .4 Flange gaskets: to ANSI/AWWA C111/ A21.11.
- .5 Pipe thread: taper.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Steel: to ASME B16.5
- .3 Butt-welding fittings: steel, to ASME B16.9

2.4 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2-1/2 and larger: flanged ends.
- .2 Ball Valves:
 - .1 NPS 2 and under: cast high tensile bronze to ASTM B62 or brass to ASTM B16/B16M, tamper proof stem with TFE seal, chrome plated brass solid full port ball, Teflon seats.
- .3 Butterfly valves: to MSS-SP-67:
 - .1 NPS 2-1/2 and over: lug type
- .4 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified this section.
 - .2 NPS 2 and under:
 - .1 Mechanical Rooms: Ball valve.
 - .2 Elsewhere: Ball valve.
- .5 Drain valves: Ball valve.

- .6 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.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

PART 3 EXECUTION

3.1 CIRCUIT BALANCING VALVES

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

3.2 CLEANING, FLUSHING AND START-UP

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

3.3 BALANCING

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

3.4 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 SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME BPVC.VIII.1, ASME Boiler and Pressure Vessel Code Section VIII, Division 1 - Rules for Construction of Pressure Vessels.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data in accordance with Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 EXPANSION TANKS

- .1 Horizontal or vertical steel pressurized removable bladder type expansion tank as per schedule.
- .2 Bladder in EPDM suitable for 115°C (240°F) operating temperature (water and glycol).
- .3 Working pressure: 862 kPa (125 psi) with ASME stamp and certification including Canadian Registration Number (CRN).
- .4 Air pre-charged to initial fill pressure of system as per schedule.
- .5 Saddles for horizontal installation Base mount for vertical installation.
- .6 Supports: Provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- .7 Capacity: as per schedule.
- .8 Acceptable materials: Amtrol, Expanflex, Bell & Gossett, Armstrong.

2.2 AUTOMATIC AIR VENT

- .1 System vents (hot water, glycol & chilled water):
 - .1 Industrial float vent: cast iron body and NPS ¾ connection and rated at 1034 kPa working pressure.
 - .2 Float: solid material suitable for 115°C working temperature.
 - .3 Acceptable materials: Spirax/Sarco Model 13WS.

- .2 Coil Vents (all equipment headers & high points in system):
 - .1 Industrial float vent: brass alloy body and NPS ½ connection and rated at 1034 kPa working pressure.
 - .2 Float: stainless steel with viton rubber valve seal suitable for 115°C working temperature.
 - .3 Acceptable materials: Spirax/Sarco Model AE30.

2.3 WATER MAKE-UP COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: to capacities as per schedule.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.
- .4 Working pressure: 1034 kPa.

2.4 COMBINATION HYDRAULIC SEPARATOR & AIR/DIRT ELIMINATOR

- .1 Furnish and install as shown on the drawings and schedule a full flow coalescing type combination air eliminator, dirt separator, hydraulic separator for the hot and chilled water systems. Selection shall be based upon system flows with pipe size as a minimum in accordance with the basis of design.
- .2 Separator shall be fabricated steel, rated for 150 psig working pressure, stamped, and registered in accordance with ASME BPVC.VIII.1 for unfired pressure vessels, and include three performance chambers within the vessel. One chamber above the higher nozzle set for air elimination, one below the lower nozzle set for dirt separation, and one between the nozzles for hydraulic separation. The vessel diameter, height above and below the nozzles, and distance between the nozzles must be equal to the basis of design.
- .3 Unit shall include internal elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
- .4 Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
- .5 Provide removal head to facilitate internal element inspection or cleaning if required. Elements shall include tube sheets top and bottom and be manufactured as a bundle for ease of removal. Verify space required for bundle removal.
- .6 Acceptable material: Spirovent Quad® Series VXN with removable head as manufactured by Spirotherm, Inc.

2.5 PIPELINE STRAINER

- .1 NPS ½ to 2: threaded connections:
 - .1 Wye-pattern, lead-free cast iron body.
 - .2 Screen: 304 stainless steel #20 mesh.
 - .3 Maximum working pressure: 2.75 MPa (400 psi) at 66°C (15°F) and 1.70 MPa (250 psi) at 208°C (406°F).
 - .4 Tapped retainer cap.

- .2 NPS 2½ to 12: class 125, flanged connections:
 - .1 Wye-pattern, lead-free cast iron body.
 - .2 Screen: stainless steel with perforations between 5 mm and 6 mm.
 - .3 Maximum working pressure: 1.4 MPa (200 psi) at 99°C (210°F) and 0.85 MPa (125 psi) at 178°C (353°F).
 - .4 Cast iron flange retainer cap with gasket tapped for closure plug.
 - .5 Drain/blow-off connection furnished with closure plug.
- .3 Acceptable material: Crane, Watts, Victaulic, Kitz, Jenkins, Toyo, Conbraco.

PART 3 EXECUTION

3.1 GENERAL

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines and blow off connections to terminate above nearest drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request, and follow Engineer's directive.
- .5 Check shop drawings for conformance of all tapings for ancillaries and for equipment operating weights.
- .6 During filling of hydronic systems or equipment, vent systems & equipment properly to remove air prior to opening equipment piping to overall system. Air propagating to system, will be the responsibility of contractor to remove.

3.2 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve larger than NPS 1 and radiation except at radiation and as indicated.

3.3 AUTOMATIC AIR VENTS

- .1 Install automatic air vents at high points of piping systems.
- .2 Install full port ball at each automatic air vent.
- .3 Air vents must have minimum connection of 13 mm (½").

3.4 EXPANSION TANKS

- .1 Adjust expansion tank pressure to suit design criteria.
- .2 Provide isolation valve on water inlet and drain valve between isolation valve and tank.
- .3 Install tee connection at air inlet to tank c/w pressure gauge and isolation valves for pressure gauge and fill connection.
- .4 Charge tank with nitrogen to required minimum operating pressure.

3.5 PRESSURE SAFETY RELIEF VALVES

- .1 Water run discharge pipe to terminate above nearest drain.
- .2 Glycol run discharge pipe to terminate at glycol tank.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA).
- .2 Hydraulic Institute Standards.
- .3 Underwriters Laboratories (UL)
 - .1 UL 778, Motor Operated Water Pumps.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories, and controllers.
- .3 Submit product data of pump curves for review showing points of operation.
- .4 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 VARIABLE SPEED INLINE PUMP

- .1 Circulating pumps shall be rated to a minimum 1000 kPa (145 psi) and 110°C (230°F) and where applicable, bear the approval symbol of the required regulatory body.
- .2 Electrical assemblies (circuitry, wiring terminals and internal connections) of the circulating pumps shall be certified and registered to bear the emblem of UL, CSA or ETL as required. Electrical assembly shall meet codes and standards established by national bodies.
- .3 Terminal Boxes:
 - .1 The circulating pumps shall have a high-quality composite terminal box with NPT electrical connections and a secure, gasketed cover, Class 2 protection level. Included on the face of the terminal box cover is the single adjustment button, front readable graphical pump display, field adjustable for horizontal or vertical positioning of the terminal box.
 - .2 The display shall indicate:
 - .1 Operation status
 - .2 Control mode

- .3 Differential pressure or speed/setpoint
- .4 Fault and warning signals
- .4 Electrical Connections:
 - .1 Circulating pump shall have a coded terminal strip indicating common/neutral/ ground within the terminal box for field connections.
- .5 Electrical General:
 - .1 All low voltage interface (IF) wiring shall be of 18 gauge or larger, UL/CSA approved, 104°C (220°F) maximum 75°C (167°F) minimum temperature.
 - .2 All 208 V main power wiring shall be of 14 gauge or larger, UL/CSA approved, 104°C (230°F) maximum 75°C (167°F) minimum temperature.
 - .3 The motor shall be a minimum of class H winding insulation as defined by UL 778 and shall be to Section 23 05 13 - Motors, Drives and Guards for Mechanical Systems.
 - .4 Voltage variances shall be less than $\pm 10\%$ from rated voltage with pump under load conditions. Maximum amperage not to be exceeded is indicated on the pump nameplate. Electrical power to the pump is confirmed when the face of the graphic display is lit.
- .6 Control, Operation and Diagnostics:
 - .1 Wet rotor, glandless inline circulating pumps shall include electronic variable speed control to operate at constant/variable differential pressure control without external sensors. Automatic night setback control available as standard using "self taught, FUZZI" technology.
 - .2 Pumps to include integrated synchronous motors using ECM technology with permanent magnetic rotors, special sensorless control electronics and single-phase electronic converters.
 - .3 Pumps to include IR (Infra-red) interface for wireless communication with the optional infra-red monitor.
 - .4 Integrated overload motor protection shall protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor, and dry run (no load condition).
 - .5 Fault contact "FC" terminals shall be included in the terminal box and are to be potentially free, normally closed contacts that open on the event of a failure.
 - .6 Interface (IF) modules will be included and installed in the terminal box. The modules will allow BMS communication via BacNet, 0-10 V DC control of speed or head setpoint, external minimum speed, external off, dual pump communication and pump operation status.
- .7 Materials and Construction:
 - .1 Circulating pumps shall be constructed with Cast-Iron bodies with factory applied Cathaphoresis coating.
 - .2 Shafts shall be constructed of high-quality stainless steel. Motor bearings shall be metal impregnated carbon sleeve bearing type. Impellers will be constructed of a high strength, glass filled polypropylene engineered composite.
- .8 Capacity: Refer to Schedule on drawing.
- .9 Acceptable material: Armstrong, Grundfos, Plad and Xylem (Bell & Gossett).

2.2 END SUCTION DIFFUSER

- .1 Body: Cast or ductile iron.
- .2 Guide Vanes: Cast or ductile iron.
- .3 Strainer: Stainless steel, 3 mm perf.
- .4 Start-up Strainer: Fine mesh galvanized steel.
- .5 Pressure & temperature rating to match that of associated pump.
- .6 Flanged connections.
- .7 Supplied by pump manufacturer, as indicated on pump schedule.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible. Install motor in orientation as recommended by manufacturer.
- .2 Allow for on site alignment and certification of base mounted end suction pumps by manufacturer's representative.
- .3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to nearest floor drain c/w full port ball valve.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install ball valves on pump suction & discharge tap-ins for pressure gauge.
- .8 All pumps to be installed in accordance with Hydraulic Institute Standards.
- .9 Provide flexible connectors on suction and discharge of all pumps with exception of in-line circulators.
- .10 On vertical in-line pumps, where specified, replace flush line filter following commissioning & startup.

3.2 START-UP

- .1 General
 - .1 In accordance with Section 25 01 11 - Commissioning - Mechanical Systems; supplemented as specified herein.
- .2 Procedures:
 - .1 Before starting pump, check that cooling water system, over-temperature and other protective devices are installed and operative.
 - .2 Provide on site alignment and certification by manufacturer's representative of base mounted end suction pumps.
 - .3 After starting pump, check for proper, safe operation.
 - .4 Check installation, operation of mechanical seals. Adjust, as necessary.
 - .5 Check base for free-floating, no obstructions under base.

- .6 Run-in pumps for 12 continuous hours.
- .7 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
- .8 Eliminate air from scroll casing.
- .9 Adjust water flow rate through water-cooled bearings.
- .10 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
- .11 Adjust alignment of piping and conduit to ensure true flexibility at all times.
- .12 Eliminate cavitation, flashing and air entrainment.
- .13 Adjust pump shaft seals, stuffing boxes, glands.
- .14 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .15 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .16 Verify lubricating oil levels.
- .17 Remove end suction diffuser start-up strainers after one week of pump operation.

3.3 PERFORMANCE VERIFICATION (PV)

- .1 General
 - .1 In accordance with manufacturer's recommendations.
- .2 Exclusions:
 - .1 Performance verification does not apply to small in-line circulators.
- .3 Assumptions: These PV procedures assume that:
 - .1 Manufacturer's performance curves are accurate.
 - .2 Valves on pump suction and discharge provide tight shut-off.
- .4 Net Positive Suction Head (NPSH):
 - .1 Application: Measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
 - .2 Measure using procedures prescribed in the Standard.
 - .3 Where procedures do not exist, discontinue PV, report to Engineer, and await instructions.
- .5 Multiple Pump Installations - Series and Parallel:
 - .1 Repeat PV procedures specified above for pump performance and pump for BHP combinations of pump operations.
- .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .7 Commissioning Reports: In accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning., supplemented as specified herein. Reports to include:
 - .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

- .2 Report forms as specified Section 25 01 11 -EMCS: Start-up, Verification and Commissioning.
- .3 Pump performance curves (family of curves).

END OF SECTION

February 2026

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B228.1, Pipe, Ducts and Fittings for Residential Type Air Conditioning Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA (Fire) 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA 016, HVAC Air Duct Leakage Test Manual.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate following:
 - .1 Sealants
 - .2 Tape
 - .3 Proprietary Joints

1.4 CERTIFICATION OF RATINGS

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

PART 2 PRODUCTS

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum System Total Pressure Pa	SMACNA Seal Class
500	A
250	A
125	A

- .2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant.

February 2026

- .3 Application:
 - .1 All new & existing supply ductwork.
 - .2 All new return & exhaust ductwork.

2.2 SEALANT

- .1 Sealant: Indoor/outdoor water-based duct sealant c/w UV inhibitors. Flame spread rating of 0. Smoke developed rating of 0. Temperature range of -20°F to +200°F.
 - .1 Acceptable material: Carlisle Hardcast CCWI-181, or equal.

2.3 DUCT LEAKAGE

- .1 In accordance with SMACNA 016.

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: standard radius: 1.5 times width of duct.
 - .2 Round: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm (16"): with single thickness turning vanes.
 - .2 Over 400 mm (16"): with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with 45° entry on branch.
 - .2 Round main and branch: enter main duct at 45° with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
- .5 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.5 FIRESTOPPING

- .1 Retaining angles all around duct, on both sides of fire separation.
- .2 Firestopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A924/A924M, Z90 zinc coating.
- .2 Thickness, fabrication, and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

February 2026

2.7 ESCUTCHEON ANGLES

- .1 40 mm x 40 mm angle iron frame on both sides of exposed rectangular or round ducts, on both sides of non-rated partitions. Escutcheon angles material & gauge shall be equal to base material.

2.8 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm (20").
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: black steel angle with black steel rods to SMACNA and following table:

Duct Size (in.)	Angle Size (in.)	Rod Size (in.)
up to 30	1 x 1 x 1/8	1/4
31 to 42	1½ x 1½ x 1/8	1/4
43 to 60	1½ x 1½ x 1/8	2/5
61 to 84	2 x 2 x 1/8	2/5
85 to 96	2 x 2 x 1/5	2/5
97 and over	2 x 2 x 1/4	2/5

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .3 For steel beams: manufactured beam clamps.

PART 3 EXECUTION

3.1 GENERAL

- .1 Do work in accordance with NFPA (Fire) 90A, NFPA (Fire) 90B, CSA B228.1 and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm (4") beyond insulated duct.
- .3 Support risers in accordance with ASHRAE and SMACNA.
- .4 Install breakaway joints in ductwork on each side of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths to accommodate installation of acoustic duct lining.
- .7 Install escutcheon sheet metal angles on both sides of exposed rectangular or round ducts on both sides of non-rated partitions. Seal void with acoustic sealant.

3.2 HANGERS

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

Duct Size mm (in.)	Spacing m (ft.)
to 1500 (60)	3 (10)
1525 (61) and over	2.5 (8)

February 2026

3.3 SEALING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.

3.4 LEAKAGE TESTS

- .1 In accordance with SMACNA 016.
- .2 Do leakage tests for supply duct; maximum leakage rate 1% at 1½ times operating static pressure.
- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Install no additional ductwork until trial test has been passed.
- .5 Test section minimum of 100 ft. long with not less than 3 branch takeoffs and two 90° elbows.
- .6 Complete test before insulation or concealment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .2 Canadian Standards Association (CSA)
 - .1 CSA B228.1, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.

1.4 CERTIFICATION OF RATINGS

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

PART 2 PRODUCTS

2.1 GENERAL

- .1 Manufacture in accordance with CSA B228.1.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 0.6 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at - 40°C to +90°C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: 2 sash locks complete with safety chain.
 - .2 301 to 450 mm: 4 sash locks complete with safety chain.

- .3 Hold open devices.

2.4 SPIN-IN COLLARS

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

PART 3 EXECUTION

3.1 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 each side of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access doors and viewing panels:
 - .1 Size:
 - .1 450 x 450 mm for servicing entry.
 - .2 300 x 300 mm for viewing.
 - .2 Location:
 - .1 At fire and smoke dampers.
 - .2 At control dampers.
 - .3 At devices requiring maintenance.
 - .4 At locations required by code.
 - .5 At reheat coils.
 - .6 Elsewhere as indicated.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA 1966, HVAC Duct Construction Standards - Metal and Flexible.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm (4").
- .3 For rectangular ducts adjustable lever with shaft extension to accommodate insulation thickness.
- .4 For round branch ducts adjustable lever with shaft extension to accommodate insulation thickness.
- .5 Inside and outside nylon end bearings.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 All dampers to be vibration free.
- .6 Ensure damper operators are observable and accessible.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C177, Standard Test Method for Steady-State Heat Flux and Thermal Measurements Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 51.10, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA (Fire) 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA 1966, HVAC Duct Construction Standards - Metal and Flexible.
- .5 Underwriters' Laboratories of Canada
 - .1 CAN/ULC S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Flame spread rating shall not exceed 25. Smoke developed classification shall not exceed 50 when tested in accordance with CAN/ULC S102.

2.2 FIBROUS DUCT LINER

- .1 Fibrous glass or "textile" fibrous, flexible glass duct liner; air stream side faced with mat facing.
- .2 Use on flat surfaces where indicated.
- .3 25 mm (1") thick, to CAN/CGSB-51.10, fibrous glass flexible duct liner.
- .4 Density: 24 kg/m³ (1.5 PCF) minimum.
- .5 Thermal resistance to be minimum 0.76m²·°C/W for 25 mm thickness when tested in accordance with ASTM C177, at 24°C mean temperature.

2.3 FASTENERS

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

2.4 JOINT TAPE

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

2.5 SEALER

- .1 Meet requirements of NFPA (Fire) 90A and NFPA (Fire) 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -68°C to +93°C.

PART 3 EXECUTION

3.1 GENERAL

- .1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA 1966, except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
 - .2 In addition to adhesive, install weld pins not less than two (2) rows per surface and not more than 425 mm on centres.

3.3 JOINTS

- .1 Seal all butt joints, exposed edges, weld pin and clip penetrations and all damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply 2 coats of sealer over tape.
- .2 Replace badly damaged areas of liner at discretion of Engineer.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.3 MANUFACTURED ITEMS

- .1 Grilles, registers, and diffusers of same generic type to be product of one manufacturer.

1.4 CERTIFICATION OF RATINGS

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

PART 2 PRODUCTS

2.1 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Coordinate mounting arrangement with ceiling types as shown on architectural drawings.
- .3 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners.
- .4 Concealed operators.
- .5 Acceptable material: E.H Price Ltd., Nailor, Titus, Krueger, Metal-aire.

2.2 SUPPLY DIFFUSERS

- .1 Type SD1: steel, square diffuser with adjustable pattern 600 mm x 600 mm off-white. Equivalent to E.H. Price Model SCD.

2.3 RETURN AND EXHAUST GRILLES AND REGISTER

- .1 Type RG1: aluminum, 13 mm x 13 mm egg crate type face bars, baked white enamel finish, ducted where indicated. Size 600 mm x 150 mm unless otherwise indicated. Equivalent to E.H. Price Model 80.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME BPVC.IV, ASME Boiler and Pressure Vessel Code, Section IV: Heating Boilers.
- .2 Canadian Standards Association (CSA).
 - .1 CSA B139, Installation code for oil-burning equipment.
 - .2 CSA B149.1, Natural Gas Installation Code.
 - .3 CSA B149.2, Propane Storage and Handling Code.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate the following:
 - .1 General arrangement showing terminal points, instrumentation test connections.
 - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
 - .3 Anchor bolt arrangements.
 - .4 Piping hook-ups.
 - .5 Equipment electrical drawings.
 - .6 Burners and controls.
 - .7 All miscellaneous equipment.
 - .8 Flame safety control system.
 - .9 Venting configuration.
- .3 Engineering data to include:
 - .1 Boiler efficiency at 25%, 50%, 75%, 100% of design capacity.
 - .2 Radiant heat loss at 100% design capacity.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 CONDENSING BOILER

- .1 Pressure Vessel
 - .1 The boiler shall be designed with a horizontal primary combustion chamber which allows sufficient depth for an unrestricted and clean combustion. A secondary, vertically

arranged, corrosion-resistant Inox-Crossal heat exchanger shall extract energy from flue gases via a high rate of flue gas condensation. The primary combustion chamber, the secondary vertical "Inox-Crossal" wafer-shaped heat exchanger plates, and the flue gas condensate collector shall be constructed of SA 240 - 316 Ti stainless steel for high operating reliability and a long service life. The outer pressure vessel walls shall be made of carbon steel.

- .2 Emission levels shall not exceed 94 mg/ kWh NOx and 40 ppm CO. Efficiencies in excess of 95% can be achieved.
- .3 Non-fin heat transfer surfaces shall be generously designed with wide water passageways in between plates, and a large water volume on the pressure vessel side to enhance heat transfer. Boiler shall not require a flow switch and shall have, at maximum flow rate, a flow restriction of less than 3.5 ft. w.c.
- .4 The pressure vessel shall be mounted horizontally on a boiler-skid complete with 4 levelling bolts to ensure proper drainage of all condensates. The front section of the primary heat exchanger shall be removable for easier handling into a boiler room.
- .5 Boiler enclosure panels shall be electrostatically powder-coated and encase the boiler shell outside with 3"/76 mm mineral wool insulation wrap-around blanket complete with nylon backing. Wire and cable entry to boiler shall be facilitated by flip-open strain relief to protect and reduce wear on cables. The assembled boiler shall have a hinged (left or right) swing-open combustion chamber door to provide easy access from the boiler front. Water connections shall be on the top and rear of the boiler shell. There shall be 2 separate boiler return flanges to accommodate different return water temperatures. The Vertomat VSB-89 shall include a detachable steel supply header as standard equipment.
- .6 Maximum operating pressure on the Vertomat is 30 psig, and maximum boiler water temperature is 210°F/99°C. Boiler shall be CGA and AGA approved and shall be built in compliance with ASME Section IV, carrying the "H" stamp, and a Canadian Registration Number (CRN) in Canada.
- .7 Standard equipment not mentioned above shall include the following items:
 - .1 Cast-iron safety header equipped with pressure gauge and air vent
 - .2 30 psig pressure relief valve
 - .3 Boiler drain valve.
- .8 The chimney vent pipe shall be of stainless steel Grade 316L or AL 29-4C and shall be able to handle positive pressure and flue gas condensate. Chimney, including all connector pieces and condensate drain connections must be designed, with assistance from Viessmann, by a chimney manufacturer.

.2 Burner

- .1 Weishaupt natural gas-fired power burner, Model G7. Burner shall be configured for fully modulating operation.
- .2 Burner housing shall be a cast aluminum monobloc construction with removable cover to provide access for service. Housing shall swing left or right interchangeably. Other components shall include a differential air pressure switch, a burner flange safety interlock switch, a separate combustion head for simple installation, and an observation port for viewing the flame. A single servomotor with 130° rotation for fully modulating burners shall be incorporated, controlling both air adjustment cam and gas butterfly valve. The clutch shall enable manual positioning of the servomotor.
- .3 The air intake shall be a multiple blade damper located on the suction side of the fan. The air damper is to be controlled by a single linkage from the cam.

- .4 Both the combustion head and the diffuser assembly shall be constructed of a stainless steel alloy capable of withstanding 1475°F / 800°C. Diffuser, ignition electrodes, mixing assembly must be accessible and removable without removing the burner. The gas butterfly valve shall be an integral part mounted directly on the burner housing and shall be equipped with a return spring to close the valve when the linkage is disconnected. The combustion head must be adjustable to maximize mixing pressure for high and low fire. The burner shall be factory equipped with a low-NOx combustion head.
- .5 The cam shall be formed with 2 strips of spring steel. Adjustment of modulating cam using 7 screws equally spaced over 130°.
- .6 The blower motor to be three-phase and totally enclosed including dynamically balanced squirrel cage fan.
- .7 The burner shall be standard equipped with electronic spark ignition. A Landis & Gyr flame safeguard system with UV scanner flame detection shall be standard equipment.
- .8 The gas train shall be preassembled and prewired consisting of two Landis & Gyr fluid powered gas valves. Consult Viessmann regarding certification approvals required by the customer for the territory in question. Gas trains shall include a separate appliance regulator.
- .9 Weishaupt burners ordered to be factory prewired to ensure optimal functionality, compliance with regional requirements, and ease of installation in the field. Include all necessary hardware items such as junction panel, burner power supply and all essential pressure switches, as well as interconnection with conduit between control and burner. Electrical drawings shall be provided upon product delivery.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Follow manufacturer's installation instructions. The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to the following codes (latest editions):
 - .1 Canada Installation Code CSA B149.1, CSA B149.2 or CSA B139.
- .2 Once the installation is complete, the heating contractor must familiarize the system operator/ultimate owner with all equipment. The installation, adjustment, service, and maintenance of this equipment must be performed by a licensed professional heating contractor.
- .3 Certified TSSA contractor shall pay all fees & cost and make application to TSSA fuels branch division to field certify the burner, boiler, venting & gas for assembly.
- .4 All burner boiler, venting and gas assembly work shall be installed & certified by a provincially certified gas fitter I Level mechanic.

3.2 START-UP AND COMMISSIONING

- .1 The heating boiler and burner shall be started up, calibrated and the combustion results verified by a Viessmann technician. The combustion results as specified must be met.
- .2 The boiler control system must be programmed, calibrated and tested on site by a qualified technician to ensure the controls meet the required parameters specified.
- .3 Documentation of the commissioning report will include the start up report, combustion test results and control set up. A copy of this report is to be supplied to the Engineering office responsible for the project.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 62.1, Ventilation and Acceptable Indoor Air Quality in Residential Buildings
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus
- .3 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No. 60335-1, Household and similar electrical appliances - Safety - Part 1: General requirements
- .4 Underwriters Laboratories (UL)
 - .1 UL 60335-1, Standard for Safety Household and Similar Electrical Appliances.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate:
 - .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired, and piped ready for final connection to building system, its size and recommended bypass connections.
 - .2 Piping, valves, fitting shipped loose showing final location in assembly.
 - .3 Control equipment shipped loose, showing final location in assembly.
 - .4 Complete internal wiring and any external panel wiring, both as schematics and as actually assembled.
 - .5 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes, and location of mounting bolt holes; include mass distribution drawings showing point loads.
 - .6 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories, controllers.
 - .7 Fan performance curves.
 - .8 Details of vibration isolation.
 - .9 Estimate of sound levels to be expected across each individual octave band in dB referred to A rating.
 - .10 Type of refrigerant used.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate:
 - .1 Brief description of unit, indexed, with details of function, operation, control, and service for each component.
- .3 Manufacturer's installation instructions shall govern and unless otherwise noted, operation, maintenance, and service of items. Include names and addresses of spare part suppliers.
- .4 Include following:
 - .1 Provide for each unit, manufacturer's name, type, year, number of units, and capacity.

PART 2 PRODUCTS

2.1 AHU-1, AHU-2, AHU-3, AND AHU-4

- .1 Unit Cabinet:
 - .1 Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at a 750- hour salt spray test per ASTM-B117 standards.
 - .2 Indoor blower sections shall be insulated with up to 1" thick insulation coated on the airside. Either aluminum foil faced or elastomeric rubber insulation shall be used in the unit's compartments and be fastened to prevent insulation from entering the air stream.
 - .3 Cabinet doors shall be hinged with toolless access for easy servicing and maintenance.
 - .4 Full perimeter base rails.
 - .5 Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating bypass of the coils.
 - .6 Condensate pan shall be slide out design, constructed of a noncorrosive material, internally sloped and conforming to ASHRAE 62-B9 standards. Condensate connection shall be a minimum of ¾" I.D. female and be rigid mount connection.
- .2 Supply Fan:
 - .1 Fan shall be a belt drive assembly and include an adjustable pitch motor pulley. Units shall be designed to operate within the service factor.
 - .2 Fan wheel shall be double inlet type with forward curve blades, dynamically balanced to operate smoothly throughout the entire range of operation.
 - .3 Bearings shall be sealed and permanently lubricated for longer life and no maintenance.
 - .4 Entire blower assembly and motor shall be slide out design.
- .3 Condenser Fan
 - .1 Fans shall be of the direct drive type, discharge air vertically, have aluminum blades riveted to corrosion resistant steel spider brackets.
 - .2 Shall be dynamically balanced for smooth operation.
 - .3 The outdoor fan motors shall have permanently lubricated bearings internally protected against overload conditions and staged independently.
 - .4 A cleaning window shall be provided on two sides of the units for coil cleaning.

- .4 Refrigerant Components:
 - .1 Compressors: Shall be fully hermetic type, direct drive, internally protected with internal high-pressure relief and over temperature protection. The hermetic motor shall be suction gas cooled and have a voltage range of $\pm 10\%$ of the unit nameplate voltage. Shall have internal spring isolation and sound muffling to minimize vibration and noise, and be externally isolated on a dedicated, independent mounting.
 - .2 Evaporator Coil: Shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed. Special Phenolic coating shall be available as a factory option. Evaporator coils shall be of the direct expansion, draw-thru design.
 - .3 Condenser Coil: Shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed or Micro-Channel aluminum tube, aluminum fins. Shall be of the draw-thru design.
 - .4 Refrigerant Circuit and Refrigerant Safety Components shall include:
 - .1 Independent fixed-orifice or thermally operated expansion devices.
 - .2 Solid core filter drier/strainer to eliminate any moisture or foreign matter.
 - .3 Accessible service gage connections on both suction and discharge lines to charge, evacuate, and measure refrigerant pressure during any necessary servicing or troubleshooting, without losing charge.
 - .4 The unit shall have two independent refrigerant circuits, equally split in 50% capacity increments.
- .5 Gas Heating:
 - .1 The heat exchanger shall be of the tubular type and constructed of stainless steel. Burners shall be of the in-shot type.
 - .2 All gas piping shall enter the unit cabinet at a single location.
 - .3 An integrated control board shall provide timed control of evaporator fan functioning and burner ignition.
- .6 Energy Recovery Ventilator (ERV)
 - .1 Cabinet: ERV shall be designed to attach directly to the rooftop unit. Cabinet material to be G90 galvanized material with a powdered enamel paint finish electrostatically bonded to the metal. Cabinet panels shall be fully insulated to prevent sweating and minimize sound. Openings shall be provided for power connections. Lifting devices will be provided for rigging. Test ports shall be provided so airflow can be measured across the energy recovery wheel.
 - .2 Intake & Exhaust Air Blowers: ERV shall contain centrifugal blowers equipped with direct drive PSC blower motors. Each motor will be multiple speed and will be individually controlled. Airflow will also be adjustable by means of a damper on the intake air opening. Blowers and motors will be removable through means of a connecting plug for ease of servicing.
 - .3 Energy Recovery Wheel: The energy recovery device shall be a rotary heat exchanger per ART Standard 1060 description. The device will be an enthalpy wheel coated with a silica gel desiccant by a patented process without the use of binders or adhesives which may plug the desiccant aperture. The substrate shall be a lightweight polymer. Desiccant shall not dissolve or deliquesce in the presence of water or high humidity. The wheel shall be easily cleanable with standard coil cleaning solution. The wheel will easily be removable from the cabinet for cleaning. All diameter and perimeter seals shall be

provided. The energy recovery cassette shall be Underwriters Laboratories Recognized Component for electrical and fire safety.

- .4 Filters: All units shall be provided with mist eliminator type filters in the intake air hood.
- .5 Power Connection: The ERV shall be provided with a single point power connection for high voltage.
- .6 Low Ambient Kit: Furnish and install the optional low ambient kit to prevent frost formation on the energy recovery wheel.
- .7 Motorized Intake Air Damper: Furnish and install the optional motorized intake air damper.
- .7 Unit Controls:
 - .1 Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.
 - .2 Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit should any of the following standard safety devices trip and shut off compressor:
 - .1 Loss-of-charge/Low-pressure switch.
 - .2 High-pressure switch.
 - .3 Freeze condition sensor on evaporator coil. If any of these safety devices trip, the LCD screen will display the alarm message.
 - .3 Unit shall incorporate "AUTO RESET" compressor over temperature, over current protection.
 - .4 Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.
 - .5 Unit control board shall have on-board diagnostics and fault message display.
 - .6 Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to a selectable value as low as -17.8°C.
 - .7 Control board shall monitor each refrigerant safety switch independently.
- .8 Electrical:
 - .1 All unit power wiring shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry.
 - .2 Separate side and bottom openings shall be provided for the control wiring.
- .9 Warranty:
 - .1 Compressor – 5 Years
 - .2 Heat Exchanger (Gas Heating) - 10 Years
 - .3 Parts - 1 Year

2.2 AHU-5, AHU-6, AND AHU-7

- .1 Casing:
 - .1 Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Finish to be in compliance with compliance with ASTM B117.

- .2 2 inch thick Antimicrobial two component rigid polyurethane foam insulation, metal encapsulated with no exposed edges.
- .3 The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up.
- .4 The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed.
- .2 Indoor Coils:
 - .1 Internally finned, inch copper tubes mechanically bonded to a configured aluminum plate fin shall be standard.
 - .2 Leak tested to 500 psig and pressure tested to 500 psig.
 - .3 Stainless Steel double-sloped condensate drain pan with provision for through the unit wall condensate drain is standard.
 - .4 Interlaced rows for superior sensible and latent cooling.
 - .5 Reheat: modulating hot-gas reheat coil located on the leaving air side of the evaporator coil pre-piped and circuited with a low-pressure switch.
- .3 Condenser Coil:
 - .1 Internally finned, copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Fin design with slight gaps for ease of cleaning.
 - .2 Leak tested to 500 psig and pressure tested to 500 psig.
- .4 Compressors:
 - .1 Digital Scroll (1st circuit only):
 - .1 Direct-drive, hermetic, digital scroll type compressors with centrifugal type oil pumps, and equipped with crankcase heaters.
 - .2 Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
 - .3 Internal overloads shall be provided with the scroll compressors.
 - .4 Compressor shall be able to fully modulate from 20%-100%.
- .5 Natural Gas Heating:
 - .1 Primary heat is supplied using indirect fired gas heating.
 - .2 Progressive tubular heat exchanger design using Stainless Steel burners and type 439 Stainless Steel tubes.
 - .3 An induced draft combustion blower shall be used to pull the combustion products through the firing tubes.
 - .4 Direct spark ignition (DS) system
- .6 Fan Motors:
 - .1 Direct drive type with factory installed Variable Frequency Drive. All motors shall be thermally protected.
- .7 ERV-Composite Construction with Frost Control and Bypass:
 - .1 Rotating wheel heat exchanger is composed of a rotating cylinder in an insulated cassette frame complete with removable energy transfer media, seals, drive motor and drive belt.

- .2 Energy transfer media shall be constructed of a durable synthetic lightweight polymer. The total energy recovery wheel is coated with a desiccant that shall be either Type-A silica gel or 3A molecular sieve and permanently bonded to the energy transfer media without the use of binders or adhesives.
- .3 Coated segments are cleanable outside of the cabinet with detergent or alkaline coil cleaner and water. Desiccant will not dissolve nor deliquesce in the presence of water or high humidity.
- .8 Hailguards:
 - .1 Installed on the outside of the condenser coil. The guards shall consist of perforated metal, of the same gauge and color as the unit itself. Airflow through the hail guards shall not be restricted due to location or size of the perforations. Guards shall be removable to accommodate coil cleaning.
- .9 Filters:
 - .1 Aluminum Mesh Filters (D, K and N Cabinets) and Galvanized Mesh Bird Screen (B and G Cabinets) shall be installed on the intake of the unit. In addition, one row of 2 inch MERV-8 rated prefilters (30 percent) and 2 inch MERV-13 final filter (80 percent).
 - .2 Frame shall be field-adjustable to match any filter combination specified in the attached selection.
- .10 Refrigerant:
 - .1 All units shall be fully charged with R-454B. Units shall be ETL listed and labeled, classified in accordance with UL 60335-2-40/CSA C22.2 No. 60335-2-40 for Central Cooling Air Conditioners. Canadian units shall be CSA Certified.
- .11 Electrical:
 - .1 Single point connections.
 - .2 Refer to drawing schedule for specific details.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install as per manufacturer's instructions.
- .2 Manufacturer to certify installation, supervise start-up and commission unit.
- .3 Submit start-up report for Engineer's review.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus

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 unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Equipment, capacity and piping connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with the manufacturer's requirements.

PART 2 PRODUCTS

2.1 FORCED FLOW HYDRONIC HEATER

- .1 Cabinet:
 - .1 The chassis is the structural frame constructed of 18 gauge galvanized steel.
 - .2 Unit is acoustically insulated with closed cell insulation.
 - .3 Front panels are of 16 gauge galvanized steel. All other panel parts are of 18 gauge galvanized steel.
 - .4 All cabinet parts are made rigid by channel forming.
 - .5 End panels are removable for piping access. The front panel is removable without the use of tools.
- .2 Unit Finish:
 - .1 All cabinet parts are cleaned, bonderized, phosphatized, and painted with one of six decorator colors. Standard finish meets ASTM B117 specifications (salt spray test).

- .3 Fan:
 - .1 The galvanized steel fan wheels are centrifugal forward-curved and double-width. Fan wheels and housings are corrosion resistant. Fan housings are constructed of formed sheet metal.
 - .2 All motors are brushless DC (BLDC) electronically commutated motors (ECM) factory programmed and run tested in assembled units.
 - .3 The motor controller is mounted in a control box with a built-in integrated user interface and LED tachometer.
 - .4 Motors will soft ramp between speeds to lessen the acoustics due to sudden speed changes.
 - .5 Integral overload protection with a maximum ambient operating temperature of 40°C and use permanently sealed ball bearings.
 - .6 Speed Control incorporates a 0-10VDC signal providing limitless control of the motor RPM between the factory set low and high speeds.
- .4 Coil:
 - .1 All hot water coils are burst tested at 450 PSIG (air) and leak tested at 100 PSIG (air under water). Maximum main coil working pressure is 300 PSIG. Maximum entering water temperature is 93°C. Tubes and U-bends are 3/8" (10 mm) O.D. copper. Fins are aluminum and are mechanically bonded to the copper tubes. Coil connections are expanded to accept standard 5/8" (16 mm) O.D. copper tubing.
 - .2 The hydronic coil shall include an auto air vent that is rated to 125 psig.
 - .3 Right hand coil connection with no interconnecting piping is provided.
- .5 Filters:
 - .1 A 1" MERV 8 filter is provided in the unit.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Hot water units: for each unit, install ball valve on inlet and calibrated balancing valve on outlet of each unit. Install drain valve at low point.
 - .1 Install manual air vent at high point.
- .3 Clean finned tubes and comb straight.
- .4 Provide supplementary suspension steel as required.
- .5 Install thermostats in locations indicated.
- .6 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by unit heaters installation.

END OF SECTION

February 2026

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 DEFINITIONS

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfil required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
 - .1 Outage of main power supply in excess of back-up power sources, provided that:
 - .1 Automatic initiation of back-up was accomplished.
 - .2 Automatic shut-down and re-start of components was as specified.
 - .2 Failure of communications link, provided that:
 - .1 Controller automatically and correctly operated in stand-alone mode.
 - .2 Failure was not due to failure of any specified EMCS equipment.
 - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
 - .1 System recorded said fault.
 - .2 Equipment defaulted to fail-safe mode.
 - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

- .1 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intent.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 20 05 01 - Mechanical General Requirements
- .2 Final Report: submit report to Consultant.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor
 - .3 Report format to be approved by Consultant before commissioning is started.
 - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Consultant in accordance with Section 20 05 01 - Mechanical General Requirements.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

February 2026

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Consultant before interim acceptance in accordance with Section 20 05 01 - Mechanical General Requirements.

1.6 COMMISSIONING

- .1 Carry out commissioning under direction of and in presence of Commissioning Agent.
- .2 Inform, and obtain approval from Consultant in writing at least 14 days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
- .3 Correct deficiencies, re-test in presence of Commissioning Agent until satisfactory performance is obtained.
- .4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .5 Load system with project software.
- .6 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Consultant.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

PART 3 EXECUTION

3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.

February 2026

- .2 Commission each system using procedures prescribed by the Commissioning Agent.
- .3 Commission integrated systems using procedures prescribed by Commissioning Agent.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of field tests of equipment just prior to installation.
 - .2 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .3 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .4 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
 - .5 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
 - .6 Cx Agent to mark instruments tracking within 0.5% in both directions as "approved for installation".
 - .7 Transmitters above 0.5% error will be rejected.
 - .8 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D converter.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.

February 2026

- .9 Verify each CDL including energy optimization programs.
- .10 Debug software.
- .11 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space for commissioning technician and Cx Agent. This document will be used in final startup testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Cx Agent and provide:
 - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 Cx Agent's acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.
 - .5 O&M personnel to assist in commissioning procedures as part of training.
 - .6 Commissioning to be supervised by qualified supervisory personnel and Cx Agent.
 - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
 - .8 Operate systems as long as necessary to commission entire project.
 - .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 30 consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
 - .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
 - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
 - .6 Correct defects when they occur and before resuming tests.
- .5 Cx Agent to verify reported results.

February 2026

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Cx Agent, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Cx Agent operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 20 05 01 - Mechanical General Requirements, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Consultant 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion that training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

- .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Consultant reserves right to approve instructors.

1.5 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

1.6 TIME FOR TRAINING

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 TRAINING PROGRAM

- .1 The program to begin before 30-day test period at time mutually agreeable to Contractor, and Client.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30-day test period.
 - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
 - .5 Equipment maintenance training: provide personnel with training in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
 - .6 Programmers: provide personnel in following subjects in approximate percentages of total course shown:

Software and architecture:	10%
Application programs:	15%
Controller programming:	50%
Troubleshooting and debugging:	10%
Color graphic generation:	15%

1.9 MONITORING OF TRAINING

- .1 Cx Agent to monitor training program and may modify schedule and content.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 The Instrumentation, Systems and Automation Society (ISA)
 - .1 ISA 5.5, Graphic Symbols for Process Displays.
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA Z234.1, Canadian Metric Practice Guide.
- .3 Electrical Safety Authority (ESA)
- .4 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

1.3 ACRONYMS AND ABBREVIATIONS

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level.
 - .2 AI - Analog Input.
 - .3 AIT - Agreement on International Trade.
 - .4 AO - Analog Output.
 - .5 BACnet - Building Automation and Control Network.
 - .6 DI - Digital Input.
 - .7 DO - Digital Output.
 - .8 DP - Differential Pressure.
 - .9 ECU - Equipment Control Unit.
 - .10 EMCS - Energy Monitoring and Control System.
 - .11 HVAC - Heating, Ventilation, Air Conditioning.
 - .12 IDE - Interface Device Equipment.
 - .13 I/O - Input/Output.
 - .14 LAN - Local Area Network.
 - .15 LCU - Local Control Unit.
 - .16 MCU - Master Control Unit.
 - .17 NC - Normally Closed.
 - .18 NO - Normally Open.
 - .19 O&M - Operation and Maintenance.
 - .20 OWS - Operator Work Station.

.21 SP - Static Pressure.

1.4 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
 - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
 - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ISA S5.5.
 - .1 Printouts: to IEEE 260.1.
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.5 SYSTEM DESCRIPTION

- .1 Refer to control schematics for system architecture.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O point summary tables.

- .3 OWS(s).
- .4 Data communications equipment necessary to effect EMCS data transmission system.
- .5 Field control devices.
- .6 Software/Hardware complete with full documentation.
- .7 Complete operating and maintenance manuals.
- .8 Training of personnel.
- .9 Acceptance tests, technical support during commissioning, full documentation.
- .10 Wiring interface co-ordination of equipment supplied by others.
- .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Consultant prior to installation.
 - .3 Location of controllers as reviewed by Consultant prior to installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
 - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
 - .1 Provide English operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
 - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high-level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
 - .5 Include, in English:
 - .1 Input and output commands and messages from operator-initiated functions, field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).
 - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points.
 - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers.
 - .2 List existing field control devices to be re-used included in tender.

.3 Quality Control:

- .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
- .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
- .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.
- .4 For materials, whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
- .5 Permits and fees: EMCS Contractor shall apply to the Electrical Safety Authority (ESA) for an ESA Permit for work which fall under the Ontario Electrical Safety Code. Upon completion of work, the EMCS Contractor shall apply for inspection and submit the final inspection report to Engineer prior to occupancy of building.
- .6 Existing devices intended for re-use: submit test report.

1.7 QUALITY ASSURANCE

- .1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

1.8 QUALIFICATIONS

- .1 It is the School Board's intention to accept EXCLUSIVE tenders from Delta Controls certified and accredited sub-contractor to perform all new work to EMCS. The above noted vendor share the vast majority of installations throughout the Board's many facilities. Vendors possess exclusive rights to proprietary hardware/software enabling integration to the Board's existing wide area network. It will be the vendor's responsibility to maintain their current installation standards.
- .2 Controls sub-contractor shall provide pricing as per plans and specifications to the prime mechanical contractor.

1.9 EXISTING - CONTROL COMPONENTS

- .1 Utilize existing control wiring as required.
- .2 Assume responsibility for controls to be incorporated into EMCS.
 - .1 Be responsible for items repaired or replaced by Building Owner.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS.
- .3 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

1.10 DESCRIPTION OF WORK

- .1 The EMCS systems shall be supplied and installed completely under the EMCS Contractor. Control components shall be BACnet protocol. Provide the necessary control points to monitor, alarm and control the end devices as described in the sequence of operation.
- .2 The engineering, installation, calibration, software programming and checkout necessary for complete and fully operational EMCS systems, as specified hereafter, shall be provided by the EMCS Contractor.
- .3 Provide a building automation linking the rooftop units, heating plant, exhaust fans, pumps, AC units, and terminal units, etc. to central control station.
- .4 Provide controllers for all space controls and provide all 120/24 V transformers. Note: 120 V power to controls transformer by Controls contractor. Electrical power circuits available in-service rooms and in corridors - reference electrical drawings.
- .5 Provide main building network controller as required to integrate new equipment controls. Main building network controllers to be located in Custodian Room (E1).
- .6 Refer to plans and specifications for all other items included in the EMCS scope of work.

PART 2 PRODUCTS

2.1 ACCEPTABLE CONTROLS CONTRACTOR

- .1 Retain the services of the base building controls contractor.

PART 3 EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Location of local office.
 - .2 Description and location of installing and servicing technical staff.
 - .3 Names of sub-contractors and site-specific key personnel.
 - .4 Sketch of site-specific system architecture.
 - .5 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .6 Descriptive brochures.
 - .7 Sample CDL and graphics (systems schematics).
 - .8 Response time for each type of command and report.
 - .9 Item-by-item statement of compliance.
 - .10 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 20 05 01 - Mechanical General Requirements and coordinate with requirements in this Section.
- .2 Shop Drawings to consist of electronic pdf copy of design documents, shop drawings, product data and software.
- .3 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

1.5 SHOP DRAWING REVIEW

- .1 Submit shop drawings within 30 working days of award of contract and include following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller and where new EMCS ties into existing control equipment.
 - .3 Spare point capacity of each controller by number and type.

- .4 Controller locations.
- .5 Auxiliary control cabinet locations.
- .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
- .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
- .8 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and
- .9 Wiring diagrams.
- .10 Piping diagrams and hook-ups.
- .11 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
- .12 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 Complete Point Name Lists.
 - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .6 Software and programming details associated with each point.
 - .7 Manufacturer's recommended installation instructions and procedures.
 - .8 Input and output signal levels or pressures were new system ties into existing control equipment.
- .13 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .14 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans.
- .15 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .16 Listing of time of day schedules.
- .17 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .18 Type and size of memory with statement of spare memory capacity.
- .19 Full description of software programs provided.

1.6 QUALITY ASSURANCE

- .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
- .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
- .3 Review interface requirements of materials supplied by others.
- .4 Review "Sequence of Operations".
- .5 Consultant retains right to revise sequence or subsequent CDL prior to software finalization without cost to Client.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 20 05 01 - Mechanical General Requirements, supplemented and modified by requirements of this Section.
- .2 Submit Record Documents and Operation and Maintenance Manual in English and French.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 1 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.

- .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.
 - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including keystrokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
 - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
 - .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
 - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
 - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1, The Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

1.3 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 20 05 01 - Mechanical General Requirements supplemented and modified by requirements of this Section.

PART 2 PRODUCTS

2.1 NAMEPLATES FOR PANELS

- .1 Identify by plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by zip-tie or chain.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange-coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS".

2.5 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint.

2.7 T-BAR CEILING

- .1 For all equipment above ceilings shall be identified by coloured self-adhesive tab.

PART 3 EXECUTION

3.1 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

- .1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.
- .2 Section 25 05 01 – EMCS: General Requirements.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 IEEE/ANSI C2, National Electrical Safety Code
- .2 Canadian Standards Association (CSA)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.
 - .3 CSA C22.2 No. 45, Rigid Metal Conduit.
 - .4 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .5 CSA C22.3 No. 7, Underground Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 70, National Electrical Code (NEC)

1.3 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 Hard wiring between field control devices and EMCS field panels.
 - .2 Communication wiring between EMCS field panels and Master Control Unit (MCU).
 - .3 All control wiring 50 V and less for equipment supplied by the Controls Contractor will be the responsibility of the Controls Contractor. Conduit and wire associated with this is the responsibility of the Controls Contractor.
- .2 Mechanical:
 - .1 Pipe taps required for EMCS equipment will be supplied and installed by Mechanical Division.
 - .2 Wells and control valves shall be supplied by the Controls Contractor and installed by Mechanical Contractor.
 - .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Mechanical Contractor.

1.4 PERSONNEL QUALIFICATIONS

- .1 Qualified trained supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend site meetings.

PART 2 PRODUCTS

2.1 SPECIAL SUPPORTS

- .1 Structural grade steel, primed and painted after construction and before installation.

2.2 WIRING

- .1 As per requirements of Electrical Divisions.
- .2 For 50V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
- .3 For wiring under 50 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .4 Sizes:
 - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
 - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
 - .3 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.
 - .4 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair. Wiring must be continuous without joints.
 - .5 More than 4 conductors: #22 minimum solid copper.
- .5 Terminations:
 - .1 Terminate wires with screw terminal type connectors suitable for wire size and number of terminations.

2.3 CONDUIT

- .1 As per requirements of Electrical Division.
- .2 Electrical metallic tubing to CSA C22.2 No. 03. Flexible and liquid tight flexible metal conduit to CSA C22.2 No.56. Rigid steel threaded conduit to CSA C22.2 No. 45.
- .3 Junction and pull boxes: welded steel.
 - .1 Surface mounting cast FS: screw-on flat covers.
 - .2 Flush mounting: covers with 25 mm minimum extension all round.
- .4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
 - .1 Bushings and connectors: with nylon insulated throats.
 - .2 With push pennies to prevent entry of foreign materials.
- .7 Fittings for rigid conduit:
 - .1 Couplings and fittings: threaded type steel.
 - .2 Double locknuts and insulated bushings: use on sheet metal boxes.
 - .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.

- .8 Fittings for thin wall conduit:
 - .1 Connectors and couplings: steel, set screw type.

2.4 WIRING DEVICES, COVER PLATES

- .1 Conform to CSA.
- .2 Receptacles:
 - .1 Duplex: CSA type 5-15R.
 - .2 Single: CSA type 5-15R.
 - .3 Cover plates and blank plates: finish to match other plates in area.

2.5 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
 - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
 - .1 50 mm diameter and smaller: one-hole steel straps.
 - .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
 - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
 - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturers and CSA labels are visible and legible after commissioning is complete.

3.2 SUPPORTS

- .1 Install special supports as required and/or as indicated.

3.3 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Electrical Divisions, this specification.
 - .2 CSA 22.1 Canadian Electrical Code, latest edition.
 - .3 ANSI/NFPA 70.
 - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage (above 50 V) contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.

- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.4 CONDUIT SYSTEM

- .1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Field Controllers to Master Control Unit (MCU). Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fills not to exceed 40%. Design drawings do not show conduit layout.
- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Owner's Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables, and equipment:
 - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
 - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
 - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Owner's Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of Owner's Representative's written approval.
- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.

- .15 Pull boxes:
 - .1 Install in inconspicuous but accessible locations.
 - .2 Support boxes independently of connecting conduits.
 - .3 Fill boxes with paper or foam to prevent entry of construction material.
 - .4 Provide correct size of openings. Reducing washers not permitted.
 - .5 Mark location of pull boxes on record drawings.
 - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .16 Install terminal blocks or strips indicated in cabinets to Electrical Division.
- .17 Install bonding conductor for 120 volt and above in conduit.

3.5 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
 - .1 Circuits are continuous, free from shorts, unspecified grounds.
 - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Owner's Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.6 WIRING DEVICES, COVER PLATES

- .1 Receptacles:
 - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
- .2 Cover plates:
 - .1 Install suitable common cover plate where wiring devices are grouped.
 - .2 Use flush type cover plates only on flush type outlet boxes.

3.7 STARTERS, CONTROL DEVICES

- .1 Install and make control connections as indicated. Power connections above 50V by Electrical Division.
- .2 Install correct over-current devices.

- .3 Identify each control wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
 - .1 Operate switches and controls to verify functioning.
 - .2 Perform start and stop sequences of contactors and relays.
 - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.8 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.9 IDENTIFICATION

- .1 Refer to Section 25 05 54- EMCS: Identification.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.
- .2 References.
 - .1 Canada Labour Code (R.S., c. L-2)/Part I - Industrial Relations.
 - .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204, Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 20 05 01 - Mechanical General Requirements.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.

- .6 Amount and nature of materials used.
- .7 Time and date work started.
- .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Consultant.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Client as described in Submittal article.
- .2 Perform inspections during regular working hours, 08:00 to 16:30, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable minimum accuracy at 50% greater than accuracy of system displaying or logging value.
 - .2 Check and calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
 - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with Operations Supervisor to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.

- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA T529, Telecommunications Cabling Systems in Commercial Buildings.
 - .2 CSA T530, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
 - .1 IEEE 802.3TM, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
 - .2 TIA/EIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS)
 - .1 TBITS 6.9, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

1.4 SYSTEM DESCRIPTION

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529, TIA/EIA-568, CSA T530, TIA/EIA-569-A and TBITS 6.9.
 - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
 - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
 - .1 EMCS-LAN.
 - .2 Modems.
 - .3 Network interface cards.
 - .4 Network management hardware and software.
 - .5 Network components necessary for complete network.

1.5 DESIGN REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
 - .1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
 - .2 EMCS-LAN to: BACnet.
 - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
 - .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
 - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
 - .6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
 - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
 - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely to access point status and application report data or execute control functions for other devices via LAN.
 - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
 - .1 Network medium: shielded twisted cable.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
- .2 American Society of Mechanical Engineers (ASME).
- .3 Canadian Standards Association (CSA International).
- .4 National Electrical Manufacturer's Association (NEMA).

1.3 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 EXISTING CONDITIONS

- .1 Repair surfaces damaged during execution of Work.
- .2 Turn over to Client existing materials removed from Work not identified for re-use.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof and heat-resistant assembly.
- .3 Operating conditions: 0-32°C with 10-90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space does not exceed Noise Criteria (NC) of 30. Noise generated by any device must not be detectable above space ambient conditions.

2.2 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200°C and over.
 - .2 RTD's: 100 or 1000 ohm at 0°C (±0.2 ohms) platinum element with strain minimizing construction, 3 integrals anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm°C.

- .3 Sensing element: hermetically sealed.
- .4 Stem and tip construction: copper or type 304 stainless steel.
- .5 Time constant response: less than 3 seconds to temperature change of 10°C.
- .6 Immersion wells: NPS ¾, stainless-steel spring-loaded construction, with heat transfer compound compatible with sensor.
- .2 Room temperature sensor:
 - .1 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed aluminum finish, with guard.
 - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of ±0.2°C.

2.3 PRESSURE TRANSDUCERS

- .1 Requirements:
 - .1 Combined sensor and transmitter measuring pressure.
 - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
 - .2 Output signal: 4-20 mA into 500 ohm maximum load.
 - .3 Output variations: less than 0.2% full scale for supply voltage variations of ±10%.
 - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed ±0.5% of full-scale output over entire range.
 - .5 Temperature effects: not to exceed ±1.5% full scale/50°C.
 - .6 Over-pressure input protection to at least twice rated input pressure.
 - .7 Output short circuit and open circuit protection.
 - .8 Accuracy: ±1% of Full Scale.

2.4 SOLID STATE RELAYS

- .1 General:
 - .1 Relays to be socket or rail mounted.
 - .2 Relays to have LED Indicator
 - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
 - .4 Operating temperature range to be -20°C to 70°C.
 - .5 Relays to be CSA Certified.
 - .6 Input/output Isolation Voltage to be 4000 VAC at 25°C for 1 second maximum duration.
 - .7 Operational frequency range, 45 to 65 Hz.
- .2 Input:
 - .1 Control voltage, 3 to 32V DC.
 - .2 Drop out voltage, 1.2V DC.
 - .3 Maximum input current to match AO (Analog Output) board.

- .3 Output.
 - .1 AC or DC Output Model to suit application.

2.5 CONTROL VALVES

- .1 Body: globe style or characterized ball.
 - .1 Flow characteristic equal percentage.
 - .2 Flow factor (kV) as indicated on control valve schedule: CV in imperial units.
 - .3 Normally open or normally closed, as indicated.
 - .4 Two or three port, as indicated.
 - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
 - .6 Packing easily replaceable.
 - .7 Stem, stainless steel.
 - .8 Plug and seat, stainless steel.
 - .9 Disc, replaceable, material to suit application.
 - .10 NPS 2 and under:
 - .1 Screwed National Pipe Thread (NPT) tapered female connections.
 - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
 - .3 Rangeability 50:1 minimum.

2.6 ELECTRONIC/ELECTRIC VALVE ACTUATORS

- .1 Requirements:
 - .1 Construction: steel, cast iron, aluminum.
 - .2 Control signal: 0-10V DC or 4-20 mA DC.
 - .3 Positioning time: to suit application. 90 sec maximum.
 - .4 Fail to normal position as indicated.
 - .5 Scale or dial indication of actual control valve position.
 - .6 Size actuator to meet requirements and performance of control valve specifications.
 - .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
 - .8 Minimum shut-off pressure: to suit application.

2.7 PANELS

- .1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.8 WIRING & CONDUITS

- .1 In accordance with Section 26 27 26 - Wiring Devices & Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair.
- .5 Minimum conduit size for power circuits: 21 mm ($\frac{3}{4}$ ").

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturers and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .4 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.
- .5 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .3 Trace existing control wiring installation and provide updated wiring schematics including additions and deletions to control circuits before beginning Work.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size and number of terminations.
 - .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduits fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
 - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit. All wiring must be in conduit.
 - .7 Control wiring shall not be installed in same conduit as power wiring.
- .6 Install thermostats at 1200 mm AFF for barrier free applications, and at 1500 mm AFF elsewhere.

3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .4 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.5 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .2 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Engineer and include in manuals. Final payment will not be made until certificates have been submitted.

END OF SECTION

February 2026

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

1.3 SEQUENCES

- .1 General:
 - .1 Reference Points Lists, Drawings and this section for complete Operating Sequences.
- .2 Constant Volume Air Handling Units Equipped with Energy Recovery (AHU-5, AHU-6, and AHU-7)
 - .1 Start-up:
 - .1 Occupied operation begins when the unit is placed in Occupied via BAS.
 - .2 Supply Fan: After completing initial startup, the supply fan startup sequence will begin by enabling the Supply Fan Start Stop Command and setting the Supply Fan Speed Command to 50% for the initial 90 seconds of operation.
 - .2 Scheduling:
 - .1 RTU units to be scheduled in occupied mode on an adjustable time schedule, as per the School Board standards. Evenings, Saturday, Sunday & holidays shall be unoccupied mode. Each unit to be scheduled individually.
 - .3 Supply Fan Control:
 - .1 Fan speed will be set during balancing.
 - .4 Exhaust Fan Control:
 - .1 After completing the exhaust fan startup sequence, the exhaust fan controls to the return static pressure setpoint of 62.5 Pa (user adjustable).
 - .5 Discharge Temperature Control:
 - .1 Heating and Cooling Mode:
 - .1 The mode of operation will be changed from cooling to heating whenever the cooling capacity is at 0% and two associated space temperatures are below the heating setpoint minus the deadband. Heating to cooling switchover follows the opposite sequence.
 - .2 Dehumidification Mode:
 - .1 Enabled when the space humidity rises 5% above the humidity setpoint. In Dehumidification Mode, cooling is controlled to the Dehumidification Temperature Setpoint, and hot gas reheat controls to the Discharge Air Temperature Setpoint.
 - .3 Heating Mode:
 - .1 The discharge air temperature setpoint will be initially established at 16°C (user adjustable)

- .2 After the initial 2 hour warm-up period (user adjustable). The discharge air temperature will be reset to minimize the utilization of the zone reheat coils.
 - .1 If the position of any two reheat control valves are below 10%, the discharge air temperature set-point will be reduced by 2°C every 30 minutes until 2 or more of the heating valves positions are 85% but less than 90%.
 - .2 If 2 or more of the heating valves are open more than 90%, the discharge air temperature set-point will be increased by 2°C every 30 minutes until 2 or more of the heating valves positions are 85% but less than 90%.
 - .3 The discharge supply temperature will be modulated between the following limits (user adjustable):
 - .1 If the position of any two reheat control valves are below 10%, the discharge air temperature set-point will be reduced by 2°C every 30 minutes until 2 or more of the heating valves positions are 85% but less than 90%.
 - .2 If 2 or more of the heating valves are open more than 90%, the discharge air temperature set-point will be increased by 2°C every 30 minutes until 2 or more of the heating valves positions are 85% but less than 90%.
 - .3 The discharge supply temperature will be modulated between the following limits (user adjustable):
Lower Limit 12°C
Upper Limit 20°C
- .4 Cooling Mode:
 - .1 The discharge air temperature setpoint will be initially established at 13°C.
 - .2 After the initial 2-hour cooldown period (user adjustable). The discharge air temperature will be reset using the following approach:
 - .1 If two or more temperature sensors within the zone are below the cooling set-point by more than 1.5°C (user adjustable) for more than 10 minutes (user adjustable), the discharge air temperature set-point will be will be increased by 2°C. A suppression period of 10 minutes (user adjustable) will be implemented.
 - .2 If two or more temperature sensors within the zone exceed the cooling set-points by more than 1.5°C (user adjustable) for more than 10 minutes (user adjustable), the discharge air temperature set-point will be will be reduced by 2°C. A suppression period of 10 minutes (user adjustable) will be implemented.
 - .3 The discharge supply temperature will be modulated between the following limits (user adjustable):
Lower limit: 12°C
Upper limit: 18°C
- .5 Provide space temperature limits on the all-space sensors to limit occupant adjustability 2°C above the summer and winter set-points.

February 2026

- .6 Energy Recovery Wheel:
 - .1 Wheel to be enabled & disabled and controlled by the unit controller.
- .7 Ventilation:
 - .1 The BAS shall adjust the outdoor air damper minimum position to maintain the return CO₂ setpoint of 1,000 PPM.
- .8 Unoccupied Mode:
 - .1 In unoccupied mode the unit will use 100% return air.
 - .2 Cooling mode: Enabled when the space temperature is above the unoccupied cooling enable setpoint and remains until space temperature.
 - .3 Heating mode: Enabled when the space temperature is below the unoccupied heating enable setpoint and remains until space temperature is 2°F above setpoint.
 - .4 Dehumidification mode: Enabled when space humidity is above the unoccupied humidity enable setpoint and remains until space humidity is 5% below setpoint.
- .9 Morning Warm-up:
 - .1 Shall be enabled at 6:00am (user adjustable).
 - .2 The RTU shall run in recirculation mode.
- .3 Reheat Coil
 - .1 The secondary circulation pumps will be enabled when the heating system is enabled.
 - .2 Circulation pumps to modulate to maintain a loop differential pressure of 15 PSI. Minimum speed to be set at 30%.
 - .3 Upon call for heat, coil control valve to open initially to 30%. Valve to modulate as required to maintain the associated room temperature setpoint.
- .4 Vestibule Heaters
 - .1 Vestibule heaters to be operational when the boiler plant is active.
 - .2 Wall mounted temperature sensor to monitor conditions. When the vestibule temperature falls 1.5°C below the setpoint, fan to be started.
 - .3 If the vestibule temperature is 1.5°C above the set-point, fan to be shut down.
 - .4 Alarm:
 - .1 If the temperature is below setpoint for more than 15 minutes (user adjustable), BAS to raise alarm.
- .5 End of Line Flush
 - .1 Valve to be actuated based on a set schedule for a duration of 5 minutes (user adjustable).
 - .2 Schedule: Monday 05:00 (user adjustable).
- .6 Trap Seal Primer
 - .1 Trap seal primer to be activated on a set schedule for 1 minute (user adjustable).
 - .2 Schedule: Everyday at 05:00 (user adjustable).

.7 Lighting

.1 Outdoor Lighting:

- .1 Enable lighting relays in lighting control panel to de-energize exterior lighting based on web-based sunrise/sunset calendar. User shall also be able to override exterior lighting during prolonged periods.
- .2 Override exterior lighting sequence when security or fire alarm input signal are received by EMCS. On receipt, enable lighting relays.

.2 Interior Lighting:

- .1 Enable lighting relays in the lighting control panel based on the following schedule:

	ON	OFF
CLASSROOMS	6:30 AM	7:00 PM
CORRIDORS	6:30 AM	7:00 PM
WASHROOMS AND SUPPPORT SPACES	6:30 AM	7:00 PM

.8 Boiler Plant:

- .1 Boiler plant to be active when the outdoor air temperature is below 15°C.
- .2 Upon a call for heating, circulation pumps to start-up.
- .3 The boilers shall be controlled by the cascade controller.
- .4 Primary pumps to be enabled by the boiler control system.
- .5 Supply water temperature to be based on the following linear reset schedule:
OAT HWS Setpoint
>0°C 50°C
<-10°C 60°C
- .6 The BAS shall monitor status and trouble alarms.

.9 Electrical Room Ventilation

- .1 The fan and motorized dampers are to be controlled by space temperature sensor. When temperature is above setpoint, fan to be energized.
- .2 When the room temperature falls 1.5°C below the setpoint, fan to be deenergized.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION