

Part 1 General

1.1 GENERAL

- .1 Provide new materials, equipment and plant of proven design and quality and of current models with published ratings for which replacement parts are readily available.

1.2 RELATED SECTIONS

- .1 Section 01 11 00 – Summary of Work.
- .2 Section 01 14 00 – Work Restrictions.
- .3 Section 01 33 00 – Submittal Procedures.
- .4 Section 01 35 25 – Special Procedures on Lockout Requirements.
- .5 Section 01 35 30 – Health and Safety Requirements.
- .6 Section 01 35 35 – Fire Safety Requirements.
- .7 Section 01 35 43 – Environmental Procedures.
- .8 Section 01 45 00 – Quality Control.
- .9 Section 01 51 00 – Temporary Utilities.
- .10 Section 01 56 00 – Temporary Barriers and Enclosures.
- .11 Section 01 61 00 – Common Product Requirements.
- .12 Section 01 74 11 – Cleaning.
- .13 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .14 Section 01 77 00 – Closeout Procedures.
- .15 Section 01 78 00 – Closeout Submittals.
- .16 Section 01 79 00 – Demonstration and Training.
- .17 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .18 Section 01 91 13 – Commissioning Plan.
- .19 Section 02 41 99 – Demolition of Minor Works.

1.3 REFERENCED CODES AND STANDARDS

- .1 Use following latest editions and amendments in effect at time of Tender Call:
 - AABC Associated Air Balance Council
 - AABC National Standards for Total System Balance (seventh edition)
 - ACGIH American Conference of Government Industrial Hygienists
 - ADC Air Diffusion Council
 - AMCA Air Moving and Conditioning Association
 - API American Petroleum Institute

ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers <ul style="list-style-type: none">- ASHRAE 15-2019, Safety Standard for Refrigeration Systems- ASHRAE 52.2-2017, Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size- ASHRAE 84 – 2020 - Method of Testing Air-to-Air Heat/Energy Exchangers- ASHRAE 90.1-2019 - Energy Standard for Buildings Except Low-Rise Residential Buildings- ASHRAE 135-2020 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.
ASME	American Society of Mechanical Engineers <ul style="list-style-type: none">- ASME B1.20.1 – Pipe Threads (2013)(R2018)- ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings (2018)- ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500 (2016)- ASME B31.1 - Power Piping (2020)- ASME B31.3 – Process Piping (2020)- ASME B31.9 – Building Services Piping (2020)- ASME Boiler and Pressure Vessel Code (2021)
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials AWS American Welding Society
AWWA	American Water Works Association
CaGBC	Canada Green Building Council
CEC	Canadian Electrical Code (2021)
CEMA	Canadian Electrical Manufacturers Association
CFFM	Canadian Forces Fire Marshal <ul style="list-style-type: none">- FMD 4007 - Fire Protection Services
CFUA	Canadian Fire Underwriters' Association
CGSB	Canadian General Standards Board
CGA	Canadian Gas Association
CHVAC	Canadian Heating, Ventilation and Air Conditioning Code (NRC)
CSA	Canadian Standards Association <ul style="list-style-type: none">- CSA 2.6-13 - Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas Fired Duct Furnaces- CSA 4.3-19 - Gas Fired Water Heaters- CSA 4.7-19 - Gas Fired Pool Heaters- CSA B44.1-19 – Safety Code for Elevators and Escalators- CSA B51-19 - Boiler, Pressure Vessel, and Pressure Piping Code- CSA B52-18 - Mechanical Refrigeration Code- CSA B64.10-17 – Backflow Prevention Devices- CSA B79-08 (R2018) – Commercial and Residential Drains and Cleanouts- CSA B126-13 (R2018) - Water Cisterns- CSA B128.1-06 (R2011) – Non Potable Water Systems- CSA B137-17 – Thermal Plastic Pressure Pipe Compendium- CSA B139-19 – Installation Code for Oil Burning Equipment

	- CSA B149.1-20 - Natural Gas and Propane Installation Code
	- CSA B149.2-20 – Propane Storage and Handling Code
	- CSA B242-05 (R2021) – Groove and Shoulder Type Mechanical Pipe Coupling
	- CSA B356-10 (R2020) – Water Pressure Reducing Valves for Domestic Water Supply Systems
	- CSA Z204-94 (1999) – Guideline for Managing Indoor Air Quality in Office Buildings
CUA	Canadian Underwriters' Association
ETL	Electrical Testing Labs
EPA	US Environmental Protection Agency
GSES	Green Seal Environmental Standards
HRA	Heating, Refrigeration and Air Conditioning Institute of Canada
LEED	Leadership in Energy and Environmental Design
MSS	Manufacturers Standardization Society
NACE	National Association of Corrosion Engineers
NADCA	National Air Duct Cleaning Association
NBC	National Building Code of Canada (2015)
NBFU	National Board of Fire Underwriters'
NBS	National Bureau of Standards
NECB	National Energy Code of Canada for Buildings (2017)
NEMA	National Electrical Manufacturers Association
NFC	National Fire Code of Canada (2015)
NFPA	National Fire Protection Association
	- NFPA 4 – Standard for Integrated Fire Protection and Life Safety System Test (2021)
	- NFPA 10, Standard for Portable Fire Extinguishers (2018)
	- NFPA 12, Standard on Carbon Dioxide Extinguishing Systems (2018)
	- NFPA 13, Standard for the Installation of Sprinkler Systems (2019).
	- NFPA 14, Standard for the Installation of Standpipe and Hose Systems (2019)
	- NFPA 17, Standard for Dry Chemical Extinguishing Systems (2021)
	- NFPA 17A, Standard for Wet Chemical Extinguishing Systems (2021)
	- NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection (2019)
	- NFPA 24, Standard for the Installation of Private Fire Service mains and Their Appurtenances (2019)
	- NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (2020)
	- NFPA 33, Standard for Spray Applications Using Flammable or Combustible Materials (2021)
	- NFPA 68, Standard on Explosion Prevention by Deflagration Venting (2018)
	- NFPA 69, Standard on Explosion Prevention Systems (2019)
	- NFPA 90A, Standard for the Installation of Air Conditioning and Ventilation Systems (2021)

	- NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems (2021)
	- NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids (2020)
	- NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations (2021)
	- NFPA 652, Standard on the Fundamentals of Combustible Dust (2019)
	- NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids. (2020)
	- NFPA 664, Standard for the Prevention of Fire and Explosions in Wood Processing and Woodworking Facilities. (2020)
NPC	National Plumbing Code of Canada (2015)
NS DOL	Nova Scotia Department of Labour and Advanced Education
NSC	National Standards of Canada
NSF	National Science Foundation
NSPI	Nova Scotia Power Inc.
SAE	Society of Automotive Engineers
SMACNA	Sheet Metal and Air Conditioning Contractors National Association Inc.
	- HVAC Duct Construction Standards, Metal and Flexible, 2006
TIAC	Thermal Insulation Association of Canada
TIMA	Thermal Insulation Manufacturers Association
UL	Underwriters' Laboratories
ULC	Underwriters' Laboratories of Canada

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submittals shall be in the metric system and use the same unit as shown in the contract documents.
- .3 Shop Drawings
 - .1 Shop drawings will be reviewed by the Departmental Representative once; review of additional shop drawing submissions will be at the expense of the submitting Contractor. Ensure shop drawings are reviewed, annotated, meet all aspects of the contract documents, and included options/accessories are clearly indicated prior to submitting. Submitting products of a manufacturer not listed in the specification without prior approval from this office constitutes a submission and subsequent review(s) will be at the contractor's expense.
 - .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia where noted.
 - .3 Submit shop drawings for all equipment listed and for all equipment the contractor wishes to substitute for provided such alternative equipment has prior approval.
 - .4 Work is not to commence until shop drawings have been reviewed by the Department Representative.

- .5 The Departmental Representative's review of these drawings is general. It is not intended to release the Contractor from necessity of furnishing materials and performing the work as required by the plans and specifications.
- .6 All shop drawings must be checked against the requirements of the plans and specifications by this Contractor prior to submitting them. Drawings not checked will be returned without review.
- .7 All shop drawings must be first quality reproductions with all details, lettering, etc. distinct and legible.
- .8 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .9 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves. (provide complete family of curves)
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .10 Upon receipt of product shop drawings by the contractor, they shall review them to ensure that they meet the specification requirements in all respects, that they are clear and legible, all options that are being provided are clearly indicated, and that dimensions, weights, power requirements, quantities and capacities are consistent with the requirements of the plans and specifications. The contractor shall complete Appendix A at the end of this section verifying that they have completed these tasks. The contractor shall then forward the shop drawings through the appropriate channels for final review by the Departmental Representative. Shop drawings that are not accompanied by Appendix A clearly indicating that the contractor has completed this review will not be reviewed by the Departmental Representative and will be returned to the contractor.
- .11 Equipment of each specification section to be submitted separately
- .12 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Operation and Maintenance Manuals:
 - .1 Operation and maintenance manual to be reviewed by, and final copies deposited with, Departmental Representative before final inspection.

- .2 Provide an electronic copy of the Maintenance Manual in pdf format to the Departmental Representative on CD, USB Memory Stick, via e-mail, DropBox, or other mutually agreed file sharing method. Maintenance Manual shall be divided into multiple files, each file or folder corresponding to a Section /Tab as outlined below. Files and Folders shall have logical names and Files shall be searchable by the pdf reader. In addition to being presented in the electronic format, the MSDS material shall be provided in a three (3) ring binder.
- .3 Binders shall be no more than 2/3 full leaving room to add material in the future. Where necessary additional binders shall be provided.
- .4 The Maintenance Manuals shall include the following:
 - .1 Have a title sheet, or sheets, preceding data on which shall be recorded Project name, date, list of contents, and Contractor's name.
 - .2 Be organized into applicable Sections of work with each Section separated by hard paper dividers with plastic covered tabs marked by Section.
 - .3 Contain a list of local (or nearest) representative of each piece of equipment including mail address, e-mail address, web site, and phone number.
 - .4 One (1) copy of each final "Reviewed" shop drawing on which have been recorded changes made during fabrication and installation.
 - .5 Typed or printed information and notes, and neatly drafted drawings.
 - .6 Maintenance and operating instructions on all building equipment supplied by the Trade Contract.
 - .7 General and specific instructions for the maintenance and operation of automatic and adjustable controls.
 - .8 Brochures and parts list for all equipment.
 - .9 Sources of supply for all proprietary products used in the work.
 - .10 Lists of supply sources for maintenance of all equipment in the project of which more detailed information is not included above.
 - .11 Lists of recommended spare parts.
 - .12 A Preventive Maintenance schedule.
 - .13 A valve tag schedule ####formatted to the existing valve tag system currently in use in the building ####including the following information as a minimum:
 - .1 Identification as per valve tag
 - .2 Location (i.e., Room Number)
 - .3 Manufacturer / Model
 - .4 Valve Type (e.g., gate, check, globe, etc.)
 - .5 Size
 - .6 Connection type (screw, flange, etc.)

- .7 Service / function (e.g., Hot Water control valve bypass)
- .8 Normal position (i.e., 'open' or 'closed')
- .5 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .2 Provide separate tab for MSDS or SDS for all hazardous material installed and left stored on site or with the Departmental Representative. First page of tab to be an index of MSDS or SDS included.
 - .3 Provide separate tab for all equipment startup reports. First page of tab to be an index of reports included.
 - .4 Provide separate tab for copies of all equipment manufacturers' warranties. A copy of the warranty to also be included with the equipment O & M data. First page of tab to be an index of warranties included.
 - .5 Provide separate tab for copies of all reports used to obtain variances from codes. First page of tab to be an index of variances.
 - .6 Provide an analysis of hydronic systems water after cleaning and treatment of piping.
 - .7 Include serial number of equipment furnished with serial numbers.
 - .8 Copy of all pipe pressure tests.
- .6 Shop Drawing and Maintenance Manual Submittal Summary

	Shop Drawings						Maintenance Manuals						
	Model No.	Dimension	Service Requirements	Weight	Electrical	Performance Data	Shop Drawing	O & M Data	Start Up Report	As-Built Drawing	Spare Parts List	MSDS / SDS	Serial No.
Common Items													
Access Doors (wall / ceiling)	•	•					•	•					
Bases and Supports		•					•			•			
Drain Valves	•	•					•						
Existing Identification Systems (note 13)													
Fire Stopping (Note 16)	•					•	•					•	
Flexible Pipe Connection	•	•					•						
Grooved Fittings and Valves	•	•		•			•	•					
Pipe									3				
Pipe Guides and Anchors	•	•					•						

	Shop Drawings						Maintenance Manuals						
	Model No.	Dimension	Service Requirements	Weight	Electrical	Performance Data	Shop Drawing	O & M Data	Start Up Report	As-Built Drawing	Spare Parts List	MSDS / SDS	Serial No.
Pipe Hangers and Supports	•	•		•			•						
Pipe Identification	•	•											
Pipe Unions	•						•						
Thermometers and Pressure Gauges	•	•				•	•						
Insulation													
Equipment		•				•	•						
Pipe		•				•	•						
Canvas and Lagging	•						•					•	
Heating													
Anchors and Guides	•	•		•			•			1			
Buried Pipe	•	•		•			•		3	•			
Heating Specialties	•	•		•		•	•						
Valves (all Services) – Anti-syphon, Balancing, Check, Coil Valve Assemblies, Fuel Oil Safety Valves, Mixing, Pressure Reducing, Pressure Relief, Pressure – Temperature Relief, Shut-off, Triple Duty	•	•		•			•	•		1			
Valve - Solenoid	•	•	•	•	•		•	•					

Note 1: Show location on 'As-Built' drawings. Note 2: Provide component dimensions.

Note 3: Provide pressure test report (dates, pressures, duration, etc.).

.5 Site records:

- .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
- .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
- .3 Use different colour waterproof ink for each service.
- .4 Make available for reference purposes and inspection.

- .6 As-Built Drawings:
 - .1 The Departmental Representative will provide one set of reproducible mechanical drawings for As-Built Drawing purposes. The Contractor shall mark thereon all significant changes and deviations from contract documents as work progresses and as changes occur.
 - .2 On a (weekly) basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
 - .3 Mark changes on white prints in 'Red'.
 - .4 Make available for reference purposes and inspection at all times.
 - .5 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built/record drawings.
 - .6 Identify each drawing in lower right hand corner in letters at least ½" high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED", (Signature of Contractor) (date).
 - .7 Submit to Departmental Representative for review and make corrections as directed.
 - .8 TAB to be performed using as-built drawings.
 - .9 The Departmental Representative shall use the Contractor's marked up As-Built Drawings to produce electronic copies, known as Record Drawings.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section
- .2 01 45 00 - Quality Control.
- .3 Provide the Departmental Representative with copies of the following inspections:
 - .1 Inspections of Municipal Plumbing Inspector
 - .2 Fire Protection System Inspections by AHJ
 - .3 NSPI inspection of control wiring.
- .4 The Contractor shall review each of the Departmental Representative's Site Observation Reports in a timely manner and sign off/respond to each item when requested. The Contractor shall forward their written response to the Departmental Representative for review."
- .5 Milestone Reviews: Before requesting a 'milestone' review (such as an above ceiling review) the Contractor shall confirm that the work is generally complete and demonstrate that they have reviewed it by each providing a punch list of the area to be reviewed.

1.6 MAINTENANCE MATERIAL

- .1 Furnish one (1) set of special or proprietary tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Identify spare parts containers as to contents and replacement parts number.

- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.
- .4 Furnish a groove tool for each drive belt size.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Inspect materials when they arrive on site and prior to final installation. Report damaged materials to Departmental Representative and seek opinion of Departmental Representative, Departmental Representative, and Manufacturer whether material can be repaired or is to be replaced. When material is to be repaired provide the work plan to the Departmental Representative for opinion and review prior to commencing work.
- .4 Store materials in a clean, dry location protected from damage. Protect equipment from dirt and dust.
- .5 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.8 TEMPORARY HEAT

- .1 Temporary Heat for new Construction shall be the responsibility of the Contractor. The use of any equipment installed on the job will only be permitted as noted in the General Conditions or in the Instructions to Bidders.
- .2 Before using any of the mechanical equipment for temporary heat service, the equipment must be installed complete with all accessories. Such equipment shall be installed and operated with all component parts in working order.
- .3 The Contractor shall be liable for all service charges and calls for any piece of mechanical equipment being used for temporary heat.
- .4 Upon completion of the work, the Contractor shall be responsible for cleaning all equipment and forwarding to the Departmental Representative, letters from equipment suppliers stating that such equipment used for temporary heat is in satisfactory operating condition and acceptable for the guarantee. The guarantee on all equipment shall be from the date of acceptance of the equipment by the Departmental Representative.
- .5 All costs for temporary heat shall be the responsibility of the Contractor.

1.9 PACKAGED EQUIPMENT

- .1 The contractor shall note that whenever 'Packaged Equipment' is specified it is intended that this equipment shall be a complete package with all necessary accessories to allow for safe automatic operation.

- .2 These accessories shall include all necessary starters, disconnects, relays, transformers, pressure switches, sensors, timers, etc. Where subject to the weather, the device shall be enclosed in a "weatherproof" enclosure.
- .3 The Contractor shall be responsible for checking with the equipment supplier to ensure that the package equipment is complete with all necessary accessories. He shall also determine which accessories are factory mounted and which ones are shipped loose with the equipment. The Contractor shall include in his Tender an amount for all necessary wiring and piping, etc. necessary to incorporate any pieces of equipment which are shipped separately into the job at no additional cost to the Departmental Representative.
- .4 The Contractor shall note that this refers to all package equipment and it shall be his responsibility to co-ordinate this with the equipment supplier and to either have the supplier include an amount in his price or the Contractor shall include the necessary amount to ensure the supply and installation of any accessories necessary for the operation of this equipment.

1.10 ELECTRICAL CONNECTIONS, MOTORS, AND STARTERS

- .1 Electrical equipment shall bear CSA label. Obtain special inspection labels required by Provincial Authority Having Jurisdiction.
- .2 Use 1750 rpm, open drip-proof, ball bearing motors manufactured to CEMA standard for 40°C temperature rise and designed for continuous service and vibration free, quiet operation.
- .3 Where motors may be subject to high moisture levels such as in the air stream after cooling coils or in areas subject to washdown, such motors will be splashproof or totally enclosed fan cooled.
- .4 Conform to requirements of Canadian Electrical Code, Local and Municipal and Provincial Authorities, and specified standards.
- .5 All equipment not located in mechanical rooms shall be supplied complete with a disconnect switch. Where exposed to the weather, "weatherproof" disconnects shall be provided.
- .6 Contractor to provide a dedicated 120/1/60 electrical circuit in the Ellis Lab Building (lower floor) to power the new wall-mounted leak detection control panel. Electrical circuit to be run in 13 mm EMT conduit to the nearest electrical circuit breaker panel.

1.11 BELT DRIVES

- .1 Provide high efficiency notched / cogged belts for all belt driven equipment.
- .2 Provide a minimum of two (2) belts for motors larger than 1 hp.
- .3 Multiple belts shall be matched
- .4 Provide for each belt drive a perforated galvanized iron belt guard, constructed with a round galvanized iron frame and access openings for tachometers.

1.12 CONTROLS

- .1 Controls to be completed by a local and authorized Delta Controls representative within the province of Nova Scotia, with up-to-date factory training and ongoing direct support from the Delta Controls factory.
- .2 The graphics package shall be consistent with the existing EnteliWEB OWS graphics. Submit the proposed graphics package as a shop drawing to the Departmental Representative for review and response prior to implementation of the package.
- .3 Contractor shall be responsible for all licences, site keys, and dongles required to edit the existing EnteliWEB Delta Controls building automation system.

1.13 PROTECTION OF OPENINGS

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

1.14 PAINTING

- .1 Where finish painting is required, prime painting by the appropriate contractor.
- .2 Piping, ductwork, and equipment identification is the responsibility of the appropriate contractor.
- .3 Apply to hangers, supports and equipment fabricated from ferrous metals at least one (1) coat of corrosion resistant paint before shipment to job site.
- .4 Prime and touch up marred finished paintwork to match original.
- .5 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up. Do not paint over nameplates.

1.15 DEMONSTRATION OF COMPLETE SYSTEM

- .1 At the conclusion of the job the Contractor shall review and demonstrate to the Departmental Representative all equipment and their respective functions, operation, and maintenance. Such demonstration shall be provided for such reasonable periods of time as the complexity of the job warrants, and as approved by the Departmental Representative. Such review and demonstration shall be made by an authorized representative of the Contractor, fully knowledgeable of the project, its installation, and operation.
- .2 Demonstrations shall not be done until:
 - .1 O & M Manuals have been reviewed by the Departmental Representative and recommended for acceptance.
 - .2 TAB has been completed and ALL deficiencies identified during TAB rectified.
 - .3 Contractor performed equipment start-up, testing, and verification completed, and ALL issues identified during this process rectified.
 - .4 Third party commissioning completed and ALL issues identified during this process rectified.

- .3 Two (2) weeks in advance of scheduled training Contractor to provide the Departmental Representative with:
 - .1 An agenda
 - .2 A biography of the instructor(s)
 - .3 Electronic copy of Training Materials specific to the agenda.
- .4 Training of each piece of Equipment or System to be scheduled with the Departmental Representative and Departmental Representative to allow maintenance staff sufficient time for their regular duties.
- .5 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .6 Use operation and maintenance manual, as-built/record drawings, audio visual aids, etc. as part of instruction materials.
- .7 Instruction duration time requirements as specified in appropriate sections.
- .8 Should any deficiencies be discovered during training the deficiencies shall be corrected by the Contractor and the training session will be rescheduled.
- .9 The Departmental Representative reserves the right to reject the Instructor or modify the agenda if either are deemed unacceptable.
- .10 Where deemed necessary, the Departmental Representative and/or Departmental Representative may record these demonstrations for future reference.

1.16 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of fans, air handling units, plenums, etc.
- .2 Clean the job site daily. If the site is not cleaned to the Departmental Representative's satisfaction, then the Departmental Representative shall make arrangements for cleaning and charge the cost against the Contract.
- .3 At conclusion of project remove surplus material, rubbish, tools, and equipment.

1.17 DEFINITIONS

- .1 Provide - "supply and install" unless otherwise indicated.
- .2 Standard of Acceptance – Only the product listed may be used unless alternate products are included in an addendum.
- .3 Supply – Contractor under whose section the product is listed is to furnish the product to the site or manufacturer of other equipment as specified at no cost to the equipment manufacturer. This contractor also responsible to carry the warrantee for product supplied.

1.18 DRAWINGS AND SPECIFICATIONS

- .1 Not intended to show structural details or architectural features.

- .2 Except where dimensioned, indicates general mechanical layouts only. Do not scale.
- .3 The existing buried piping and conduit infrastructure (i.e., GPS locate) information indicated on the Design Drawings was determined by Stantec. The Contractor shall review and verify this information prior to ordering the new buried piping and fittings.
- .4 If required by the Departmental Representative, provide field drawings to show the relative position of various services. Obtain the Departmental Representative's review before beginning work.
- .5 The Contractor shall check the content of the drawings, specifications, and dimensions, and before proceeding, report to the Departmental Representative any error or omission between Mechanical and Civil plans.
- .6 These specifications are to be considered as an integral part of the drawings which accompany them, neither the drawings nor specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other, shall be considered properly and sufficiently specified and must, therefore, be provided under the Contract. Where a conflict exists between specification and drawings the more stringent requirement shall apply. The decision of the Departmental Representative shall be final, if interpretation is required.
- .7 Misinterpretation of drawings and specifications shall not relieve the Contractor of responsibility.
- .8 All Contractors shall make themselves familiar with the overall intended operation of the mechanical systems prior to installation so that all necessary accessories such as dampers, vents, valves, controls, etc., can be installed during the normal progress of the work. Failure to do so will result in the Contractor's responsibility in providing such devices, at his expense when the need of such devices becomes apparent during start-up.

1.19 SITE VISITS

- .1 Before commencing work, visit site and verify that requirements of Plans and Specifications are consistent with site conditions.
- .2 Advise Departmental Representative, in writing, of any discrepancies or conflicts.
- .3 No allowance shall be made for failure to include items which a thorough investigation would have shown to be required.

1.20 GUARANTEES

- .1 The Contractor shall guarantee all their work free from defects for a period of one (1) year, unless specifically noted otherwise, after final acceptance of such work by the Departmental Representative and shall make good all defects other than normal wear and tear during the life of the guarantee. The Contractor shall guarantee all work and equipment supplied by them to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the above guarantee. At any time during this period, they shall make any necessary changes and adjustments or replacements, to accomplish this at their own expense.
- .2 Submit manufacturers' written guarantees to the Departmental Representative for review.
- .3 Provide copies of all guarantees in a separate tab of the O & M manual.
- .4 Each guarantee shall include:
 - .1 Project name and address.
 - .2 Guarantee time period (commencement date shall be as date shown on Project Final Certificate of Completion unless otherwise indicated).
 - .3 Clear and concise definition of what is guaranteed and remedial action provided.
 - .4 Signatures of the Contractor and a company officer of the manufacturing firm.
 - .5 Include all extended guarantees (and service contracts) as specified in individual sections.
- .5 Provide Extended Guarantees for:

Guarantee Period (years, commencing at end of Standard 1 Year Warrantee)			
Buried Piping System	5		

1.21 PERMITS AND REGULATIONS

- .1 All Contractors shall comply with all regulations of authorities having jurisdiction, where applicable, including but not limited to the following:
 - .1 Provincial Department of Labour
 - .2 Provincial Fire Marshal
 - .3 Municipal Plumbing Inspector
 - .4 Provincial Board of Insurance Underwriters
 - .5 Provincial Department of Health
- .2 The Contractor shall obtain and pay for any permits required by Local Codes and Regulations and arrange for inspections.
- .3 Any additional materials or labour required to conform to any of these rules and regulations will be furnished under the Contract with no additional cost to the Departmental Representative.

1.22 CO-ORDINATION

- .1 Co-ordinate work to avoid conflicts.
- .2 Locate distribution systems, equipment and materials to provide minimum interference and maximum useable space.
- .3 Co-ordinate location of duct drops, pipe drops and risers with trades erecting walls and ceilings to ensure that all pipes and ducts are concealed in walls or ceilings spaces. If space is not available in walls or ceilings, locate ducts and pipes so that they can be easily boxed in by the relevant trades. Where pipes are shown rising in concrete block walls, placement of the pipe shall be done in conjunction with the erection of the wall.
- .4 The Contractor shall meet regularly with the structural and other relevant trades during the production of coordination drawings to obtain physical dimension, access requirements and preferred location for the services.
- .5 In the event that conflicts arise, the Contractor shall work with all other relevant Contractor(s) to ensure that the necessary adjustments are made so that all components fit in the space available with adequate clearance for servicing and removal. If after a through effort to fit equipment in a space and provide adequate space for servicing and removal, the Contractor determines that additional space is required, they may request assistance to resolve the issue through the Departmental Representative.
- .6 All adjustments or re-routing of the mechanical, electrical and sprinkler systems required to avoid conflict and provide adequate space for servicing and removal of equipment shall be made at the expense of the relevant contractor.
- .7 Prepare coordination drawings showing the routing of main ducts, piping mains. Main sprinkler pipe, electrical conduit runs, and sprinkler piping in critical areas shall be shown.
- .8 Rerouting of pipes and ducts to be reviewed by the Contractor.

1.23 ALTERNATES

- .1 Should the Contractor desire to substitute another material for one or more specified by name, they shall apply in writing for such permission at least ten (10) calendar days before closing date of the Tender package. They shall also provide data and/or samples for the Departmental Representative's consideration. The Contractor shall be fully responsible for any additional costs that might result due to equipment substitution.
- .2 Equipment submitted as alternate to that specified on the drawings or in the specifications by model number or catalogue reference must be capable of meeting the full range of operating parameters as the specified equipment. It must also be configured and set to meet the specific design point parameters as called for on the plans or in the specifications.

- .3 The Contractor shall note that all layouts on the mechanical drawings are based on the specified equipment and any changes necessitated in service connections, etc., will be done at the Contractor's expense. Furthermore, if it is found that the provisions made regarding space conditions are not met, the right is reserved by the Departmental Representatives to require installation of the equipment used preparing the layout.

1.24 CUTTING AND PATCHING

- .1 Cutting and patching to be performed by each sub-contractor for penetrations less than or equal to 8" dia. or 8" x 8". Co-ordinate larger penetrations with the Contractor.
- .2 Make every effort to minimize cutting and patching and provide dimensions, locations and other data for bases, sleeves, boxes, etc., to be built in as construction proceeds. Set sleeves and make openings in concrete forms and masonry before placing concrete and masonry.

1.25 EXCAVATION AND BACKFILLING

- .1 Excavation and backfilling will be performed by the Contractor.

1.26 PIPE TESTS

- .1 Notice of Tests: Give written notice for a minimum of four (4) working days prior to date when tests will be made.
- .2 Prior Tests: Concealed or insulated work shall remain uncovered until completely tested and approved, but if construction schedule requires, arrange for prior tests on parts of system as approved.
- .3 Acceptance Tests: Conduct in presence of the Departmental Representative's representative or representative of the Authorities Having Jurisdiction.
- .4 Costs: Bear all costs in connection with tests conducted.
- .5 Certificates: Obtain acceptance certificates from the authorities having jurisdiction. Work is not considered complete until certificates have been delivered to the Departmental Representative.
- .6 An air test is acceptable in lieu of a water test for metal piping systems. Pneumatic (compressed air) testing of plastic piping systems is not permitted for safety reasons.
- .7 See Section 23 05 05 – Installation of Pipework for testing requirements.
- .8 Hammer test all welded joints.
- .9 Provide Test Reports to the Departmental Representative and include them in the final Maintenance Manual.

1.27 SLEEVES AND ESCUTCHEONS

- .1 See Section 23 05 05 – Installation of Pipework.

1.28 DI-ELECTRIC UNIONS

- .1 All connections between steel and copper or brass for pipe 2" and smaller shall be made of di-electric unions, except on all closed systems. On pipe 2½" and larger, use flanged connections with non-metallic gasket and plastic sleeves for bolts.

1.29 COMPLETION

- .1 Nothing herein contained can be constructed to relieve the Trade from making good and perfect work in all usual details of construction and in accordance with best standard practice and in strict compliance with provisions of any and all laws and ordinances, and the rules and regulations of any duly constituted public body having jurisdiction over this work.
- .2 This Trade shall be held responsible to provide and furnish all necessary labour and to bear all expenses incidental to the satisfactory completion of the work.

1.30 DEPARTMENTAL REPRESENTATIVE SUPPLIED EQUIPMENT

- .1 Take delivery of and install certain pieces of equipment which is being provided by the Departmental Representative.
- .2 Provide all necessary piping and duct connections to leave the equipment ready for operation.

1.31 MANUFACTURER'S REVIEW

- .1 It shall be the responsibility of the Contractor to have the equipment supplier or his representative review all proposed connections, clearances, sizes, valves, breakers, etc. including wire and pipe sizes to his equipment before installation commences. At that time, he shall inform the Departmental Representative of any changes required to make the equipment function satisfactorily.
- .2 Provide the Contractor with a letter accepting all connections as proposed and where required, recommend necessary changes.
- .3 If any changes or additional material and labour are required to make the equipment function properly to capacity and the manufacturer has not pointed out this work prior to commencement of work, the additional and/or corrective work shall then be done at the expense of the equipment supplier.

1.32 RELATED WORK PERFORMED BY OTHERS

- .1 Excavating and backfilling.
- .2 Concrete housekeeping pads to be smooth, level, and c/w chamfered edges.
- .3 Saw-cutting of concrete/masonry walls, floors and/or ceilings (larger than 200 mm dia or 200 mm x 200 mm openings).
- .4 Work of other trades not to be supported from mechanical equipment, pipes, ducts, conduits or their supports.

1.33 RELATED WORK PERFORMED BY THIS SECTION

- .1 Welding
 - .1 All welding to be performed by Contractor for all mechanical piping and structural supports and hangers.
 - .2 All welding shall be performed by certified welders in accordance with the Provincial Labour Requirements.
 - .3 See also Section 23 05 17 - Pipe Welding.
- .2 Support
 - .1 Work of each sub trade to be supported directly from structure independent of other sub trades unless prior approval obtained from the Departmental Representative.

1.34 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in Submittal section above.
- .2 All work to be performed by qualified personal or with appropriate training and qualifications in the field in which they are engaged. Apprentices and labourers shall be under the continuous supervision of a qualified tradesperson.
- .3 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Submittal section above.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

1.35 BREAKDOWN OF CONTRACT VALUE

- .1 Submit a breakdown of contract value to the Departmental Representative prior to commencement of work.
- .2 This breakdown shall be used as the basis for the Contractor's Progress Claim.
- .3 The breakdown shall be reviewed and approved by the Departmental Representative. Where required, evidence indicating the accuracy of the breakdown shall be submitted.
- .4 The format of the breakdown shall be as follows:

Mechanical	
.1 Mobilization	
.2 Balancing	
.3 Mechanical Insulation - Plumbing	
.4 Mechanical Insulation - Heating	

.5 Mechanical Insulation - Ventilation	
.6 Plumbing Rough-in Material	
.7 Plumbing Rough-in Labour	
.8 Plumbing Fixtures and Equipment Installation Material	
.9 Plumbing Fixtures and Equipment Installation Labour	
.10 Fire Protection Material	
.11 Fire Protection Labour	
.12 Heating Rough-in Material	
.13 Heating Rough-in Labour	
.14 Heating Equipment and Installation Material	
.15 Heating Equipment and Installation Labour	
.16 Air Distribution Rough-in Material	
.17 Air Distribution Rough-in Labour	
.18 Air Distribution Equipment and Installation Material	
.19 Air Distribution Equipment and Installation Labour	
.20 Controls - Mobilization	
.21 Controls - Rough-in	
.22 Controls - Installed Equipment or Material	
.23 Controls - Inspection and Validation	
.24 Contract Close-Out (Maintenance Manuals, Record Drawings, Training, etc)	
Sub-total (Items .1 to .24)	

Part 2 Products

2.1 NOT USED.

.1 Not used.

Part 3 Execution

3.1 FIRE STOPPING

- .1 Installation shall be completed by qualified Tradesmen, properly trained by the manufacturer and in accordance with the product listing.
- .2 Do not begin installation until substrates have been prepared in accordance with manufacturer's instructions and recommendations.
- .3 Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of fire-stopping.
- .4 Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.
- .5 Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of fire-stopping, including ducts, piping, equipment, and other suspended construction.
- .6 Verify that environmental conditions are safe and suitable for installation of fire-stopping.
- .7 If substrate preparation is the responsibility of another installer, notify the Departmental Representative of unsatisfactory preparation before proceeding.
- .8 Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to fire-stopping installation.
- .9 Install in strict accordance with manufacturer's detailed installation instructions and procedures.
- .10 Install so that openings are completely filled and material is securely adhered.
- .11 Where fire-stopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.
- .12 After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.
- .13 Repair or replace defective installations in accordance with manufacturer's recommendations, listed systems details and applicable code requirements.
- .14 Clean fire-stop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by fire-stop system manufacturer and which will not damage the surfaces being cleaned.
- .15 Notify Authority Having Jurisdiction (AHJ) when fire-stopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.
- .16 Do not cover fire-stopping with other construction until approval of authority having jurisdiction has been received.

- .17 Departmental Representative reserves the right to engage an independent testing agency to inspect installed fire-stopping and to prepare reports indicating whether the installed work complies with the contract documents.
- .18 Notify testing agency at least 7 days prior to date when fire-stopping installation will be ready for inspection; obtain advance approval of general schedule and phasing, if any, required to allow subsequent construction to proceed.
- .19 Remove left over material and debris from Work area. Use necessary means to protect fire protection product(s) before, during, and after installation.
- .20 Touch-up, repair or replace damaged products before Substantial Completion.
- .21 Install identification Labels for Through Penetration: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:
 - .1 The words "Warning - Through Penetration Fire-stop System - Do not Disturb. Notify Building Management of Any Damage."
 - .2 Listing agency's system number or designation.
 - .3 System manufacturer's name, address, and phone number.
 - .4 Installer's name, address, and phone number.
 - .5 Contractor's name, address, and phone number (if applicable).
 - .6 Date of installation.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

3.3 CONTROLS

- .1 Tie the new leak detection control panel into the existing Ellis Lab Building EMCS/BAS/BMS (Delta Controls). In the event of an alarm, an alarm notification report shall be sent to the facility operator.

3.4 CLEANING

- .1 Clean interior and exterior of all systems.

3.5 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 – Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

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

3.6 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, As-Built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Departmental Representative may record these demonstrations on video tape for future reference.

3.7 PROTECTION

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

3.1 APPENDIX A

SHOP DRAWINGS

CONTRACTOR'S REVIEW CONFIRMATION

The Shop Drawings Have Been Reviewed by the Contractor and All Items are in conformance with the Plans and Specifications? ☐ Yes ☐ No

Are Specified Model Numbers and/or Options Indicated? ☐ Yes ☐ No

If No, Explain: _____

Confirmed by Contractor: _____
Print Name

Contractor's Signature: _____

Date: _____

Item: _____

Specification Section and Item Number: _____

Drawing Reference: _____

Contractor: _____

Contractor's Project Representative: _____

Phone Number: _____ Fax Number: _____ E-mail: _____

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .7 ASTM C547-2003, Mineral Fibre Pipe Insulation.
 - .8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB).
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c.37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations.
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.

- .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
- .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 The Contractor will make available 1 copy of the systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Installer shall be a specialist in performing the Work of this section and have adequate experience in this size and type of project in accordance with the standards of TIAC.
- .2 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket. Application: hot water heating supply and return piping.
 - .1 Mineral fibre: to CAN/ULC-S702, ASTM C547.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket. Application: chilled water supply and return piping.
 - .1 Mineral fibre: to CAN/ULC-S702, ASTM C547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702, ASTM C547.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.

2.4 CEMENT

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

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

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

2.7 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colour: white.
 - .3 Minimum service temperatures: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0.5 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXISTING PIPING

- .1 Provide/add removable waterproof insulation bag for all existing non-insulated piping, valves, and/or fittings within the existing below-grade vault.

3.3 PRE-INSTALLATION REQUIREMENT

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

3.4 INSTALLATION

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

3.5 REMOVABLE, PRE-FABRICATED INSULATION AND ENCLOSURES

- .1 Application: at valves (all types) and flanges.
- .2 Design: to permit periodic removal and/or replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 Thickness of insulation as listed in following table.

Application	Temp (°C)	TIAC Code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1.1/4 to 2	2.1/2 to 4	5 to 6	8 & over
Hot Water Heating	60 - 94	A-1	25	38	38	38	38	38

- .5 Finishes:
 - .1 Exposed indoors: PVC jacket.
 - .2 Exposed in mechanical rooms: PVC jacket.
 - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .5 Finish attachments: closed.
 - .6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION