

PART 1 GENERAL**1.1 GENERAL**

- .1 This Section covers items common to all Sections of Divisions 21, 22, 23, and 25.

1.2 SCOPE OF WORK

- .1 The work of this Section includes all labour, materials, and equipment necessary for the installation complete of the mechanical systems shown on the drawings and described in these specifications.
- .2 It is the requirement of this work to provide all systems complete; functioning in intended system operation, notwithstanding that every item necessarily required may not be specifically mentioned.

1.3 EQUIPMENT LIST

- .1 Complete list of equipment and materials to be used on this project and forming part of tender documents including manufacturer's name, model number and details of materials, and submit for approval.
- .2 Submit for approval within seven (7) days after award of contract.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit Shop Drawings to Department Representative for approval.
- .3 Shop Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances, e.g. access door swing spaces.
- .4 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.

- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use Mechanical Contractors Association of Canada "Shop Drawing Submittal Title Sheet". **Identify section and paragraph number.**
- .6 Closeout Submittals:
 - .1 Provide Operation and Maintenance Data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and Maintenance Manual approved by and final copies deposited with, Department Representative before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valve schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .1 Testing, Adjusting and Balancing Reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

- .6 Approvals:
 - .1 Submit two (2) copies of draft Operation and Maintenance Manual to Department Representative for approval. Submission of individual data will not be accepted unless directed by Department Representative.
 - .2 Make changes as required and re-submit as directed by Department Representative.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Contractor shall obtain one (1) set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 Record drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of record drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Department Representative for approval and make corrections as directed.
 - .4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
 - .5 Perform completed Testing, Adjusting and Balancing for HVAC using As-built Drawings.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.6 EQUIPMENT INSTALLATION

- .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.

1.7 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 and components.

1.8 TRIAL USAGE

- .1 Department Representative and Commissioning Agent may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 EMCS.
 - .2 Air Handling Units.
 - .3 Exhaust Fans.
 - .4 Pumps.
 - .5 BAS Controls.
- .3 Use of systems during construction:
 - .1 Use of mechanical systems during construction.
 - .2 Use of new and existing permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:

- .1 Entire system is complete, commissioned, pressure tested, cleaned and flushed out.
- .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
- .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
- .4 There is no possibility of damage.
- .5 Supply ventilation systems are protected by 60% filters, inspected daily and changed every 2 weeks or more frequently as required.
- .6 Return systems have approved filters over openings, inlets and outlets.
- .7 Systems will be:
 - .1 Operated as per Manufacturer's recommendations and instructions.
 - .2 Operated by Contractor.
 - .3 Monitored continuously by Contractor.
- .8 Warranties and Guarantees are not relaxed.
- .9 Regular preventive and other Manufacturer's recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative.
- .10 Refurbish entire system before static completion; clean internally and externally, restore to "as-new" condition and replace filters in air systems.
- .3 Filters specified in this Section are over and above those specified in other Sections of this project.

1.9 PROTECTION OF OPENINGS

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

1.10 ELECTRICAL

- .1 This Contractor is responsible for all power wiring 120V and over required for operation of mechanical equipment and plant systems.

- .2 Division 25 EMCS is responsible for all wiring required for controls systems, including obtaining 120V sources from the electrical system and 208V/600V wiring for variable frequency drives (VFD's).

1.11 PREPARATION FOR FIRESTOPPING

- .1 All fire stopping is to be performed by a qualified subcontractor.
- .2 Contractor to identify all locations where mechanical penetrations are required through fire rated separations including type and sizing.
- .3 Provide all required clearances between outside surface of pipe and inside surface of sleeve, core drilled hole or listed fire rated system.

1.12 EXISTING CONDITIONS

- .1 Connect into existing systems at times coordinated with Department Representative.
- .2 Request written approval ten (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.

1.13 TESTS

- .1 Give 48 hours written notice of date for all tests.
- .2 Insulate or conceal work only after testing and approval by Department Representative.
- .3 Conduct tests in presence of Department Representative.
- .4 Bear costs including retesting and making good.
- .5 Equipment: test as specified in relevant sections.
- .6 Prior to tests, isolate all equipment or other parts, which are not designed to withstand test pressures or test medium.

1.14 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.

1.15 DEMONSTRATION, OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Where specified elsewhere in Divisions 21, 22, 23 and 25, Manufacturers to provide demonstrations and instructions.
- .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. Provide minimum 8 hour instruction.
- .5 When deemed necessary, Department Representative will record these demonstrations on video tape for future reference.

1.16 INTERPRETATION OF PLANS AND SPECIFICATIONS

- .1 These specifications are to be considered as an integral part of the plans, which accompany them, and neither the plans nor the 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 by this Contractor.
- .2 Misinterpretation of the plans or specifications shall not relieve this Contractor of responsibility; final interpretation of details and clauses remains with the Department Representative.

- .3 Where uncertainty exists in the passing of pipes and location of equipment, the Department Representative shall be consulted before work is started. Where such materials and equipment have been installed so as to cause interference with the inside treatment of the building, they shall be removed and relocated without additional cost to the Department Representative.
- .4 The plans do not necessarily show all valves, duct offsets, access panels, connections, balancing fittings, bases, isolators, flexible connections, drains, etc., and this Contractor shall not avail himself of these obvious omissions, but shall install the work complete in essential details so that it will function properly, can be easily balanced and so that repairs and removal of equipment can easily be made.
- .5 Building dimensions shall not be scaled from the plans but shall be obtained from on-site dimensions of the building. Any discrepancy between the drawings and the building shall be questioned before proceeding with any installation.

1.17 CO-OPERATION OF CONTRACTORS

- .1 This Contractor shall become familiar with the work of other Contractors and in laying out and installing the work shall co-operate with the other Contractors, so as to facilitate the progress of the work as a whole and avoid interference or delays. Where interference exists, this Contractor shall notify the Department Representative before installing the work. Any changes in the work or alterations of the Contractor's schedule of procedure required for such co-operation will not be considered as a claim for extra compensation.
- .2 Due to the complexities of many sub-trades, and the restrictive space available in this project, it is required that all trades co-operate closely so as to install all systems in their allotted locations as indicated on the drawings, or coordination on site.

1.18 ERRORS AND OMISSIONS

- .1 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.

- .2 Should this Contractor discover errors or discrepancies in the plans or specification, he shall refer the matter to the Department Representative for change or clarification and shall not proceed with that portion of the work until advised by the Department Representative to do so.

1.19 TESTING, ADJUSTING AND BALANCING (TAB)

- .1 This Contractor shall provide labour and materials to verify calibration of all pressure and temperature devices. Provide support during commissioning and verification.

1.20 MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

- .1 General:
 - .1 Electrical motors, drives and guards for mechanical equipment and systems.
 - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on Electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V, which are related to control systems specified in Division 22, 23 and 25. Refer to Division 26 for quality of materials and workmanship.
 - .4 Motor shall be inverter duty rated for use with VFD's where required.
- .2 Premium efficiency motor specifications TEFC Motors 1-200 HP:
 - .1 All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies. The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.
 - .2 Per CEE Premium Efficiency™ Criteria, minimum efficiencies for TEFC motors shall be equal to or greater than those shown below:

HP	1200 RPM	1800 PM	3600 RPM
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4

- .3 Premium efficiency motor specifications ODP motors 1-200 HP:
- .1 All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies. The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.
- .2 Per CEE Premium Efficiency™ Criteria, minimum efficiencies for TEFC motors shall be equal to or greater than those shown below:

HP	1200 RPM	1800 PM	3600 RPM
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4

1.21 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

- .3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Division 01 - General Requirements.

1.22 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia. holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.-
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.

- .3 Securely fasten in place.
- .4 Removable for servicing.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Materials and products in accordance with Division 01 - General Requirements.
- .2 Do verification requirements in accordance with Division 01 - General Requirements.

2.2 VOC LIMITS

- .1 The purpose of this section is to reduce emissions of volatile organic compounds (VOCs) and to eliminate emissions of chloroform, ethylene dichloride, methylene chloride, perchloroethylene, and trichloroethylene from the application of adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, or any other primers.
- .2 This section applies to all commercial and industrial sales and applications of adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, or any other primers, unless otherwise specifically exempted by this rule.
- .3 Requirements
 - .1 Unless otherwise specified in paragraph .2 a person shall not apply any adhesives, adhesive bonding primers, adhesive primers, or any other primer, which have a VOC content in excess of 250 g/L less water and less exempt compounds.
 - .2 A person shall not apply adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, or any other primer, which have a VOC content in excess of the limits specified below:
 - .3 **VOC Limit*, Less Water and Less Exempt Compounds in Grams per Litre**

Fig. 1

Architectural Applications	Current VOC Limit
Cove Base Adhesives	50
Multipurpose Construction Adhesives	70
Structural Glazing Adhesives	100
Single Ply Roof Membrane Adhesives	250

Fig. 2

Specialty Applications	VOC Limits and Effective Dates**			
	Current VOC Limit	1-1-05	7-1-05	1-1-07
PVC Welding	510			
CPVC Welding	490			
ABS Welding	400		325	
Plastic Cement Welding	350	250		
Adhesive Primer for Plastic	650		550	
Computer Diskette Manufacturing	350			
Contact Adhesive	80			
Special Purpose Contact Adhesive	250			
Tire Retread	100			
Adhesive Primer for Traffic Marking Tape	150			
Structural Wood Member Adhesive	140			
*Sheet Applied Rubber Lining Operations	850			
*Top and Trim Adhesive	540			250

The specified limits remain in effect unless revised limits are listed in subsequent columns.

- .4 For adhesives, adhesive bonding primers, or any other primer not regulated by the above two tables and applied to the following substrates, the following limits shall apply:

FIG. 3

Substrate Specific Applications	Current VOC Limit
Metal to Metal	30
Plastic Foams	50
Porous Material (except wood)	50
Wood	30
Fiberglass	80

- .5 If an adhesive is used to bond dissimilar substrates together the adhesive with the highest VOC content shall be allowed.

Fig. 4

Sealants	Current VOC Limit
Architectural	250
Marine Deck	760
Non-membrane Roof	300
Roadway	250
Single-Ply Roof Membrane	450
Other	420

Fig. 5

Sealant Primers	Current VOC Limit
Architectural	
Non Porous	250
Porous	775
Modified Bituminous	500
Marine Deck	760
Other	750

* For low-solid adhesives or sealants the VOC limit is expressed in grams per liter of material as determined in paragraph .3; for all other adhesives and sealants, VOC limits are expressed as grams of VOC per liter of adhesive or sealant less water and less exempt compounds as determined in paragraph .4.

- .4 GRAMS OF VOC PER LITER OF MATERIAL is the weight of VOC per

volume of material, to be used for a low-solids adhesive or sealant, and can be calculated by the following equation:

$$\text{Grams of VOC per Liter of Material} = \frac{W_s - W_w - W_{es}}{V_m}$$

Where: W_s = weight of volatile compounds, in grams

W_w = weight of water, in grams

W_{es} = weight of exempt compounds, in grams

V_m = volume of material, in liters

- .5 GRAMS OF VOC PER LITER OF ADHESIVE OR SEALANT, LESS WATER AND LESS EXEMPT COMPOUNDS is the weight of VOC per combined volume of VOC and adhesive or sealant solids, and can be calculated by the following equation:

Grams of VOC per Liter of Adhesive or Sealant, Less Water and Less

$$\text{Exempt Compounds} = \frac{W_s - W_w - W_{es}}{V_m - V_w - V_{es}}$$

Where: W_s = weight of volatile compounds, in grams

W_w = weight of water, in grams

W_{es} = weight of exempt compounds, in grams

V_m = volume of material, in liters

V_w = volume of water, in liters

V_{es} = volume of exempt compounds, in liters

For adhesives or sealants that contain reactive diluents, the VOC content of the adhesive or sealant is determined after curing. The grams of VOC per liter of any adhesive or sealant, except a low solids adhesive or sealant shall be calculated by the following equation:

Grams of VOC per Liter of Adhesive or Sealant, Less Water and Less

$$\text{Exempt Compounds} = \frac{W_{rs} - W_{rw} - W_{res}}{V_{rm} - V_{rw} - V_{res}}$$

Where: W_{rs} = weight of volatile compounds not consumed during curing, in grams W_{rw} = weight of water not consumed during curing, in grams W_{res} = weight of exempt compounds not consumed during curing, in grams V_{rm} = volume of material prior to reaction, in liters

V_w = volume of water, in liters V_{es} = volume of exempt compounds, in liters

2.3 PLENUM RATED WIRES AND CABLES

- .1 Cables and electrical wires used for transmission of sound or data and that are not located in totally enclosed non-combustible raceway shall be FT6 rated.

PART 3 EXECUTION

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 00 08 - Painting for Minor Works.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Division 01 - General Requirements and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS AND AS SPECIFIED RESPECTIVE SECTIONS.
 - .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.

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SECTION 21 05 01
COMMON WORK RESULTS FOR MECHANICAL

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3.4 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 ANSI/ASHRAE/IESNA 90.1-01-SI, Energy Standard for Buildings except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials (ASTM International):
 - .1 ASTM B209M-01, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-95 (2001), Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
 - .7 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .8 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .9 ASTM C795-92 (1998) e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .10 ASTM C921-89 (R1996), Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CGSB 51-GP-53M-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4 Thermal Insulation Association of Canada (TIAC):
 - .1 National Insulation Standards 1992 (R1999).
- .5 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102-M88 (R2000), Surface Burning Characteristics of Building Materials and Assemblies.

1.3 PRODUCT DATA

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

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.5 MANUFACTURER'S INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with 01 33 00 - Submittal Procedures.
- .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 to standards of TIAC.

DELIVERY, STORAGE AND HANDLING

- 1.7 .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

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: 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.
- .3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C547.
 - .2 Maximum "k" factor: ASTM C547.
- .4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C547.
 - .2 Jacket: to CGSB 1-GP-52Ma.
 - .3 Maximum "k" factor: ASTM C547.
- .5 TIAC Code C-1: Rigid mineral fibre board, unfaced.
 - .1 Mineral fibre: ASTM C612.
 - .2 Maximum "k" factor: ASTM C612.

- .6 TIAC Code C-4: Rigid mineral fibre board faced with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C612.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: ASTM C612.
- .7 TIAC Code C-2: Mineral fibre blanket un-faced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: ASTM C553.
- .8 TIAC Code A.6: Flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor.
 - .4 Certified by manufacturer free of potential stress corrosion cracking corrodants.
- .9 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: ASTM C533.
 - .2 Maximum "k" factor: ASTM C533.
 - .3 Design to permit periodic removal and re-installation.

2.3 CEMENT

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

2.4 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.
 - .2 Colours: white.
 - .3 Minimum service temperatures: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: 0.02 perm.

- .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .7 Covering adhesive: Compatible with insulation.
- .2 ABS plastic:
 - .1 One piece moulded type and sheet with pre formed shapes as required.
 - .2 Colours: to match adjacent finish paint selected by Departmental Representative.
 - .3 Minimum service temperatures: 40oC.
 - .4 Maximum service temperature: 82oC.
 - .5 Moisture vapour transmission: 0.012 perm.
 - .6 Thickness: 0.75 mm.
 - .7 Fastenings:
 - .1 Solvent weld adhesive compatible with insulation to seal laps and joints
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Locations:
 - .1 For outdoor use ONLY.
- .3 Canvas:
 - .1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.
- .4 Aluminum:
 - .1 In accordance with ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Smooth.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 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.

2.5 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum, 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.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation with expanded metal lath on other face.

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR VAPOUR RETARDER FINISH

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

PART 3 EXECUTION

3.1 PRE- INSTALLATION REQUIREMENTS

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

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards:
 - .1 Hot equipment: To TIAC code 1503-H.
 - .2 Cold equipment: to TIAC code 1503-C.
- .2 Elastomeric insulation to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
- .3 Provide vapour retarder as recommended by manufacturer.
- .4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

- .5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports outside vapour retarder jacket.
- .7 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: At valves, flanges, unions at equipment, pump bodies, suction guides, triple duty valves, strainers, plate and frame heat exchangers and accessories.
- .2 Installation to permit periodic removal and replacement without damage to adjacent insulation.

3.4 EQUIPMENT INSULATION SCHEDULES

- .1 Removable, pre-fabricated, insulation and enclosures as per 3.3 to be utilized. For equipment that does not require regular servicing, fixed insulation to be provided complete with jacket. This includes shell and tube heat exchangers, air separators, expansion tanks and condensate receivers. Chilled water to be complete with vapour barrier.
- .2 Hot Equipment:
 - .1 TIAC code A-1 with bands and 13 mm cement reinforced with one layer of reinforcing mesh.
 - .2 TIAC code C-2 un-faced with bands and 13 mm cement precede by one layer of reinforcing mesh.
 - .3 Thicknesses: 50 mm.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 21 07 19.

1.2 SUMMARY

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

1.3 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineer (ASHRAE):
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM):
 - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Trade Associations:
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .6 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.4 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.

1.5 SUBMITTALS

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

- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.6 QUALITY ASSURANCE

- .1 Subcontractor responsible for installation shall be a specialist in performing work of this Section.
- .2 Health and Safety:
 - .1 Construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

DELIVERY, STORAGE AND HANDLING

- 1.7**
 - .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .2 Storage and protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.
 - .3 Waste management and disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

- .2 Place excess or unused insulation and insulation accessory materials in designated containers.
- .3 Divert unused metal materials from landfill to approved metal recycling facility.
- .4 Dispose of unused adhesive material at official approved hazardous material collections site.

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°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket:
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket:
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702.
- .5 TIAC Code A-6:
 - .1 Insulation securements.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-C.
- .6 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section):
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702.

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 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 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: White.
 - .3 Minimum service temperatures: -20°C.
 - .4 Maximum service temperature: 65° C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.

- .3 Pressure sensitive vinyl tape of matching colour.
- .7 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 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 Aluminum:
 - .1 In accordance with ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Smooth.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
- .4 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

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

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes:
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1:
 - .1 Securements: SS bands 19mm 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: SS wire at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: C-2 with vapour retarder jacket:
 - .1 Insulation securements: ss. wire, 300 mm on centre
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .5 Thickness of insulation as listed in following table:
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.

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		A-1	25	38	38	38	38	38
Storm Piping		A-3	25	25	25	25	25	25

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
Domestic HWS & HWR		A-1	25	25	25	38	38	38
Domestic CWS and Chilled Water		A-3	25	25	25	25	25	25
Refrigerant Natural Gas Liquid and Section		A-6	12. 5	12.5	12.5	12.5	12.5	12.5
Steam Supply	Up to 135° C	A-1	25	50	50	50	50	50
Condensate Return	Up to 94°C	A-1	25	38	38	38	38	38

.6 Finishes:

- .1 Exposed indoors: PVC.
- .2 Exposed in mechanical rooms: PVC.
- .3 Exposed outdoors: Aluminum.
- .4 Steam/condensate: Canvas.
- .5 Refrigerant: Elastomeric.
- .6 Concealed, indoors: canvas on valves, fittings.
No further finish.
- .7 Use vapour retarder jacket on TIAC code A-3
insulation compatible with insulation.
- .8 Finish attachments: SS bands at 150 mm on centre.
- .9 Installation: to appropriate TIAC code CRF/1
through CPF/5.

3.5 FIELD QUALITY CONTROL

- .1 Verification requirements shall include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.

- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Certified wood.
- .8 Low-emitting materials.

3.6 CLEANING

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 All drawings and all division and sections of these specifications shall apply to and form an integral part of this division.

1.2 SCOPE

- .1 This specification outlines requirements for new:
 - .1 Sprinkler systems.

1.3 RELATED SECTIONS

- .1 Division 28 - Multiplex Fire Alarm System.
- .2 This Trade Contractor is to review the drawings and specifications of other trades for work relating to this trade.

1.4 CONTRACT DRAWINGS

- .1 M02 - Fire Protection Floor Plan and Mezzanine.
- .2 M03 - Fire Protection - Details.

1.5 REGULATIONS

- .1 The installation of the fire protection systems shall be in accordance with the drawings issued under this contract, these specifications, and:
 - .1 The National Building Code of Canada 2015 (NBC).
 - .2 The National Fire Code of Canada 2015 (NFC).
 - .3 The National Plumbing Code of Canada 2015.
 - .4 NFPA3, "Commissioning".
 - .5 NFPA4, "System Integration Testing".
 - .6 NFPA 13-2013, "Standard for the Installation of Sprinkler Systems".
 - .7 NFPA 10-2013, "Standard for Portable Fire Extinguishers".
 - .8 NFPA 25-2013, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems".

1.6 COMPONENTS

- .1 All system components required to be "listed" as per NFPA shall have their listing through Underwriter's Laboratories of Canada (ULC).

1.7 AUTHORITY HAVING JURISDICTION

- .1 The system is to be reviewed by the "Department Representative".

1.8 REVIEW AUTHORITY

- .1 The working (shop) drawings are to be reviewed by the Consultant. Any comments shall be directed to the Consultant for review and action.
- .2 The Contractor will forward the drawings to OFM.

1.9 SUBMISSIONS

- .1 Working (shop) drawings:
 - .1 Shop drawings and hydraulic calculations shall bear the seal and signature of a Professional Engineer licensed or registered in practice in the Province of Nova Scotia.
 - .2 Shall be submitted in strict accordance with NFPA 13 and Section 1.5.
 - .3 Floor plan drawings shall match the tender drawings scale and show required pipe routing, valves, sprinklers and all other system components.
 - .4 Plot plan showing underground services, siamese connection, and access routes.
 - .5 Cross sections of building showing floors, ceilings and sprinkler system components.
 - .6 Submit updated drawings at regularly scheduled job meetings or as requested by the Consultant during construction.
 - .7 Working (shop) drawings shall be submitted to the Consultant for review and acceptance. Work shall commence only when all submissions have been reviewed by the Consultant. Allow ten working days for the Consultant's review of each submission.
 - .8 Confirmation for full time foreman's name and provincial certification.
 - .9 All drawings shall be submitted as described above and in AutoCAD 2019 (or newer) format complete with electronic copy of each drawing.
 - .10 Submit hydraulic calculations for review.
 - .11 Complete catalogue information for devices/equipment specified.

- .12 The working drawings shall be submitted as one package.
- .13 Two (2) hard copies and one (1) PDF of each to be submitted.
- .2 Trade Contractor record drawings:
 - .1 As-Built drawings shall represent the installed system components.
 - .2 The Trade Contractor shall use reviewed (stamped) white print shop drawings. During system installation the Trade Contractor shall note any substantial variances from the reviewed drawings and shall record these variances in red pencil on these drawings.
 - .3 Identify drawings as "As-Built Copy". Maintain in new condition and make available for inspection on site and at job meetings.
 - .4 The Trade Contractor shall submit up-to-date accurate record drawings for the complete systems to the Consultant.
 - .5 The Trade Contractor shall provide folded white prints for each maintenance manual and AutoCAD files on USB drive.
- .3 Operation and Maintenance Data:
 - .1 The Trade Contractor shall provide three copies of operation and maintenance information in a 3-ring binder and drawings. Information in each binder is to include:
 - .1 Copy of reviewed (stamped) Product Data.
 - .2 Detailed periodic inspection and tests schedule per the requirements in the NFC and NFPA 25.
 - .3 Copy of record drawings (folded prints) and CAD file on USB drive.
 - .4 Copy of hydraulic calculations complete with node drawings.
 - .5 Copy of Material and Test Certificate for sprinkler systems.
 - .6 Copy of Material and Test Certificate for backflow preventer.
 - .7 Copy of Material and Test Certificate for underground pipe.
 - .8 Copy of hydraulic data nameplates.

- .9 Letter from fire department accepting threads/connection on fire department connection and hose valve connections.
- .10 Letter identifying Trade Contractor's maintenance and warranty obligations.
- .11 As-built drawings in CAD format.
- .2 Binders are to include an index and dividing tabs for each section.
- .4 Submit maintenance manuals two weeks prior to substantial completion.

1.10 TRADE CONTRACTOR

- .1 Only Trade Contractors competent in the installation of sprinkler systems, standpipe systems, and fire pumps, and who have a thorough and demonstrated knowledge of requirements in NFPA3, NFPA4, NFPA 13, NFPA 10 and NFPA 25 will be considered acceptable for this contract.
- .2 The Trade Contractor shall assign an on-the-job full-time foreman who has a sprinkler Journeypersons license. All employees working on site must hold a valid certification of qualification or a valid letter of authenticity in the occupation. Trade Contractors are required to ensure that their workers are certified in accordance with the Apprenticeship and Occupational Certification Act, Section 17(2).

1.11 SPARE PARTS

- .1 The Trade Contractor shall provide spare sprinklers as set forth in NFPA 13, and a sprinkler wrench(s). A metal cabinet(s) sized to accommodate the spare sprinklers and wrench(s) shall be provided and mounted on the wall adjacent to the header.

1.12 MAINTENANCE

- .1 The Trade Contractor shall include in their price, one year full maintenance as per the NFC and NFPA 25.
- .2 Trade Contractor to provide quarterly inspections throughout the first year. Proper forms, as per NFPA 25, shall be issued to Owner after each inspection.
- .3 Servicing, including replacement parts for the complete system, shall be readily available locally within 24 hours of the placing of a trouble call.

1.13 WARRANTY

- .1 The equipment and installation shall be under full labour and material warranty for a period of one year from certification.

1.14 CERTIFICATION

- .1 The Trade Contractor shall complete Material and Test Certificates for each sprinkler system (zone) in accordance with NFPA 13.
- .2 This Trade Contractor shall complete Material and Test Certificate for water entrance in accordance with NFPA 13.
- .3 The Trade Contractor shall provide Material and Test Certificate for the backflow preventer.
- .4 Underground Pipe Test Certificate.
- .5 Certification date shall be as posted on certificate unless otherwise directed by the Consultant.

1.15 DESIGN APPROACH

- .1 The Consultant has designed the sprinkler systems for the purpose of tendering.
- .2 The Trade Contractor shall prepare detailed design/working drawings following a detailed site and tender package review and coordination.
- .3 The Trade Contractor shall prepare hydraulic calculations matching the installation (shop) drawings.
- .4 The Trade Contractor shall install the system using the reviewed shop drawings and is responsible for confirming all pipe routing and sprinkler head locations. Any changes shall be the responsibility of the Trade Contractor and must be approved by the Consultant.
- .5 Any changes to piping or sprinkler head locations or type that, in the opinion of the Consultant, significantly alter the hydraulic design, will require confirming hydraulic calculations by this Trade Contractor.
- .6 Refer to drawings for design approaches.

1.16 SYSTEM DESCRIPTIONS

- .1 This contract includes work identified on the contract drawings and specifications.
- .2 The following shall be included for each wet pipe sprinkler system zone:
 - .1 Control valve complete with tamper switch.
 - .2 Flow switch.
 - .3 Test and drain assembly.
 - .4 Listed pressure gauges.
- .3 The following shall be included with the riser check valve.
 - .1 Riser check valve.
 - .2 Control valve complete with tamper switch.
 - .3 Listed pressure gauges.
 - .4 System header piping.
 - .5 Main drain valve and all drain piping.
 - .6 Installation and instruction manuals.
- .4 Identification tags shall be fastened to control valves and clearly indicate the appropriate system.
- .5 Hydraulic data nameplate for each system.
- .6 The systems shall be designed not to exceed 1, 205 kPa (175 psi) working pressure.

1.17 DESIGN CRITERIA

- .1 Water supply for the sprinkler system shall be based on the municipal supply.
- .2 Sprinkler contractor shall conduct a water supply test to be used in the hydraulic calculations.
- .3 Contractor responsible to provide a water supply test not older than twelve (12) months.

Part 2 Products

2.1 SPRINKLERS

- .1 All sprinklers shall be manufactured by one manufacturer and be rated for 1, 205 kPa (175 psi).

- .2 Sprinkler Heads:
 - .1 Sprinkler Head Type A: recessed pendent sprinkler head, quick response, glass bulb, 13mm (1/2") orifice, K= 81 (5.6), Temperature 68°C (155°F), 13mm (1/2")NPT thread size, chrome.
Acceptable Manufacturer: Victaulic, Tyco.
 - .2 Sprinkler Head Type B: Upright sprinkler head, quick response glass bulb, 13mm (1/2") orifice, K=81 (5.6),Temperature 68°C (155°F), 13mm (1/2") NPT thread size, brass.
Acceptable Manufacturer: Victaulic, Tyco.
 - .3 Sprinkler Head Type C: Horizontal sidewall sprinkler head quick response, glass bulb, 13mm (1/2") orifice, K=81 (5.6). Temperature 68°C (155°C),13mm (1/2") NPT thread size, chrome.
Acceptable Manufacturer: Victaulic, Tyco.

2.2 PIPING AND FITTINGS

- .1 Piping shall satisfy the following criteria:
 - .1 Steel pipe shall be of the type tested for sprinkler use as per Section 6.3 of NFPA 13, be stamped accordingly, and rated for a minimum of 2,000 kPa (300 psi). Pipe to be manufactured in Canada or the United States. All pipe must be stored inside prior to installation and have zero corrosion.
 - .2 Concealed pipe shall have red and white decals indicating sprinkler system piping every 3 m (10 ft.) along mains and risers. Brady type or equivalent.
 - .3 Galvanized pipe SCH10 for mains and SCH40 for branch lines, where applicable.
 - .4 Schedule 40 black steel for pipe 50 mm (2") or smaller.
 - .5 Schedule 10 black steel for pipe 65 mm (2½") and greater.
 - .6 Ductile iron piping from water entrance connection to backflow preventer.
 - .7 Acceptable Products: Bull Moose, and Nova Tube.
 - .8 One manufacturer to be used for all pipe.
- .2 Fittings shall satisfy the following criteria:
 - .1 Piping 65 mm (2½") and greater to be grooved.
 - .2 Piping 50 mm (2") and smaller to be threaded or grooved.

- .3 Pipe fittings and couplings are to withstand 1,205 kPa (175 psi) working pressure.
- .4 Fittings shall be of the type tested for sprinkler use as per Section 6.4 of NFPA 13. Each individual fitting is to be complete with a ULC marking, be stored inside prior to insulation, and have zero corrosion.
- .5 Screwed fittings on dry system, to the exterior, and as shown on drawings to be galvanized.
- .6 Flexible couplings on standpipe risers where they penetrate stair landings and masonry walls as required for seismic protection.
- .7 Acceptable Products (Grooved): Victaulic, Shurjoint, and Tyco.
- .8 Acceptable Products (Screwed): Ward, BMI, and Anvil Star.
- .9 One manufacturer to be used for each type (grooved and screwed) of fitting.
- .3 Flange bolts shall be square or hex head bolts with heavy hex nuts to ASTM A307-82a.
- .4 Flange gaskets shall be 1.6 mm (1/16") thick plain or cloth inserted red rubber to ASME/ANSI B16.20-1998 and ASME/ANSI B16.21-1992.
- .5 Tie rods shall be a minimum of 16 mm (5/8").
- .6 No site welding.
- .7 Exposed hangers shall have collars/plates at ceilings.

2.3 CONTROL VALVES

- .1 Only one manufacturer's valves shall be used.
- .2 Valves to be ULC listed.
- .3 Valves shall bear:
 - .1 Manufacturer's name.
 - .2 Trademark.
 - .3 Valves controlling water supply to any part of the fire suppression systems shall be:
 - .1 65 mm (2½") and greater: Victaulic Butterfly Model 705 complete with tamper switch.
 - .2 50 mm (2") and under: Victaulic Model 728 complete with tamper switch.

- .3 Victaulic Series 771 OS&Y gate valve on entrance.

- .4 Acceptable Alternates: Milwaukee, Grinnell-Gruvlok, Jenkins, Nibco, Mueller, Watts, Kennedy, Fivalco, and Global Safety Products.

2.4 SPRINKLER FLOW SWITCH

- .1 Potter VSR-F vane type water flow switch with retard and cover tamper switch kit.
- .2 Acceptable Alternate: System Sensor.

2.5 SPRINKLER TAMPER SWITCH

- .1 Switches for Butterfly and Butterball valve. Refer to Section 2.3.
- .2 Potter OSYSU for OS&Y gate valves.
- .3 Acceptable Alternates: System Sensor.

2.6 CHECK VALVE

- .1 Reliable Model D swing check valve complete with 12 mm (1/2") ball drip.
- .2 Acceptable Alternates: Viking, Tyco, Victaulic, Nibco, and Kennedy.

2.7 PIPE HANGERS AND BRACES

- .1 Piping shall be supported by hangers as per NFPA 13 2013 and NBC 2015.
- .2 Shall be ULC listed.
- .3 Pipe hanging, bracing, and restraint shall include protection of piping from damage from earthquakes.
- .4 Hangers shall be provided listed surge restraint.
- .5 C-type clamps shall be provided with restraining straps.
- .6 Clamps shall have shear type bolts.
- .7 Acceptable Products: Tolco, Erico, and Anvil.

2.8 INSPECTOR'S TEST CONNECTION/DRAINS

- .1 AFG Test-N-Drain (pre-manufactured) at zone control valves, complete with pressure relief.
- .2 Control valves, sight glass, reducing orifice, and galvanized pipe to exterior for remote test connections.
- .3 Acceptable Alternate: Victaulic.

2.9 PRESSURE GAUGES

- .1 Provide and install a listed 100 mm (4") pressure gauge on all test connection assemblies for each zone and at the top of each standpipe riser.
- .2 Acceptable Products: Winters.

2.10 SPRINKLER HEAD GUARDS/ESCUTCHEONS

- .1 To be listed for use with installed sprinkler heads.
- .2 Acceptable Product: Tyco, Victaulic.

2.11 SPRINKLER HEAD CABINETS

- .1 Lyn-Car F30-5622.
- .2 Acceptable Alternate: National Fire Equipment.

2.12 IDENTIFICATION TAGS

- .1 Required for all control valves, drain valves, inspector's test connections, trim valves and auxiliary drain valves.
- .2 Identification tags shall be red lamicoid with white letters.
- .3 Additional tagging is required on ceilings when a valve is located above.

2.13 HYDRAULIC DATA NAMEPLATES

- .1 Hydraulic nameplate signs.
- .2 Acceptable Products: Lyn-Car, National Fire Equipment.

2.14 FIRE DEPARTMENT PUMPER CONNECTION

- .1 National Fire Equipment Model 201, exposed, 100 mm x 65 mm, 65 mm (4" x 2½" x 2½") double clapper inlet complete with thread connections chrome caps, chain and wall plate.
- .2 Exterior wall plate and cover shall have chrome finish and read "Auto Spark".
- .3 Acceptable Alternates: Wilson and Cousins.

2.15 RISER CHECK VALVE

- .1 Cast body
- .2 ULC listed and FM approved
- .3 Complete with pressure relief valve
- .4 Acceptable Alternates: Victaulic, and Tyco.

2.16 ALARM SWITCH

- .1 Potter PS-10A.
- .2 Acceptable Alternate: System Sensor.

2.17 DOUBLE CHECK VALVE BACKFLOW PREVENTER

- .1 Watts Double Check Valve Assemblies:
 - .1 ULC Listed, FM approved.
 - .2 Housing & Sleeve: 304 (schedule 40) Stainless Steel
 - .3 Elastomers: EPDM, Silicone and Buna-N
 - .4 Check Disks: Reversible Silicone or EPDM
 - .5 Test Cocks: Bronze Body Nickel Plated
 - .6 Pins & Fasteners: 300 Series Stainless Steel
 - .7 Springs: Stainless Steel
 - .8 Temperature Range: 33°F-140°F (0.5°C -60°C)
 - .9 Maximum Working Pressure: 175psi (12.1 bar)
- .2 Acceptable Alternate: Wilkins (complete with OS&Y gate valves).

2.18 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

- .1 Fire Extinguishers Types FE-1 and FE-2:
 - .1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labelled for A, B and C class protection. 4.5 kg (FE-1) as indicated on drawings to comply with building hazard designation as per ANSI/NFPA 10.
- .2 Brackets Type recommended by extinguisher manufacturer.
- .3 Identification:
 - .1 Identify extinguishers in accordance with recommendations of ANSI/NFPA 10 CAN/ULC-S508.
 - .2 Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

Part 3 Execution

3.1 APPROVALS

- .1 Working (shop) drawings and hydraulic calculations shall be reviewed by the Consultant and Department Representative prior to any fabrication, ordering of material, or site work.

3.2 OBSERVATION OF CONSTRUCTION

- .1 Do not recess, paint or conceal piping, accessories, or work prior to observation of construction by Owner and/or the Consultant.
- .2 Observation of construction reports as issued by the Consultant are to be signed off (by item) by the Site Foreman when the deficiency is rectified. Reports are to be issued to the Consultant upon completion.

3.3 INSTALLATION

- .1 All system components to be installed as per the shop drawings, these specifications, and the manufacturer's recommendations.
- .2 Install control valves, drain valves, and inspector's test sight glass in a manner that will allow for easy access and use.
- .3 Trade Contractor shall allow for pipe routing to suit obstructions.

- .4 Install drains with slopes to allow for proper draining. Where more than one sprinkler system drain is located in an area, they shall be interconnected so that only one pipe exits the building.
- .5 Provide/install chrome collars around pipe at all penetrations where exposed.
- .6 Quick Response sprinklers to be installed throughout.
- .7 Install guards on all sprinkler heads where possible damage could occur.
- .8 Locate spare sprinkler head cabinet at the sprinkler riser and hydraulic data nameplates at the respective valve header.
- .9 Intermediate temperature classification sprinklers to be installed in service and elevator machine rooms.
- .10 All pipes draining to exterior shall be located a maximum of 610 mm (2' - 0") above grade and discharge on a 610 mm x 610 mm (2' - 0" x 2' - 0") concrete patio stone. Provide six (6) patio stones on roof for testing standpipe. Locate patio stones on site with Consultant.
- .11 Install sprinkler protection below obstructions in all rooms.
- .12 Install high temperature classification sprinkler heads where located within a 2,135 mm (7'-0") radius of unit heater; install intermediate temperature heads as per NFPA 13.
- .13 All sprinklers are to be centered on ceiling tiles unless shown otherwise on drawings.

3.4 FIRESTOPPING

- .1 Fire stopping will be by others. All penetrations through all separations (with and without fire resistance rating) shall be fire stopped as per the NBC.
- .2 This Trade Contractor is to assist Contractor in identifying areas for fire stopping associated with this Trade's penetrations.

3.5 TESTING AND TRAINING

- .1 This Trade Contractor shall subject all system components to operational and hydrostatic tests as per NFPA 13. Repair any leaks or defective piping that should occur during the tests.
- .2 This Trade Contractor shall provide hydraulic pump, temporary connections and labour required to perform tests.
- .3 The building maintenance staff shall be trained prior to functional testing.
- .4 This Trade Contractor shall conduct a full system functional test (sprinkler) in the presence of the Consultant/Owner. Provide foreman for a minimum of 6 (six) hours for the duration of this testing. The purpose of the test will be to verify the operation of the equipment and provide additional training to the building maintenance staff. Ten days' notice shall be given before any functional testing. Coordinate testing with fire alarm Contractor.
- .5 This Trade Contractor shall issue completed Material and Test Certificates for each sprinkler system zone, backflow preventer, and new water entrance.

3.6 CUTTING, CORE DRILLING, PATCHING AND PAINTING

- .1 All cutting, core drilling, patching, and painting shall be the responsibility of the Trade Contractor. Coordinate with other Trades and Contractor.
- .2 All exposed sprinkler piping and fittings in finished areas shall be primed and painted (anti-corrosion paint) with four coats in total on site. Colour to match ceiling finish. Confirm colour with Owner.
- .3 Apply decals.
- .4 This work shall be coordinated prior to tender close and during construction.

3.7 COORDINATION

- .1 Location of piping and equipment shall be closely coordinated with structural, architectural, plumbing, ventilation, heating, and electrical systems to avoid interference.

- .2 Sprinkler head locations are to be coordinated with all other services and ceilings. The architectural reflected ceiling plans are to be used for this purpose.
- .3 The complete tender package including architectural, kitchen, structural, mechanical (plumbing and ventilation), and electrical along with a detailed site review, shall be used in producing shop drawings.

END OF SECTION