

Part 1 General

1.1 GENERAL

- .1 This section covers items common to All Mechanical Sections.

1.2 SCOPE OF WORK

- .1 The work of the Mechanical Sections 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 completely functioning in intended system operation, notwithstanding that every item necessarily required may not be specifically mentioned.
- .3 Refer to Division 01 – General Requirements.
- .4 All solvents, sealants, adhesives and other products used on the site shall comply with limits and materials specified in Division 01 – General Requirements. The requirements of Division 01 – General Requirements shall override all other specified material properties in the specification.

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 7 days after award of contract.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Division 01 – General Requirements.
- .2 Submit shop drawings to be approved by Engineer.
- .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. eg. 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.
 - .6 In addition to transmittal letter, identify section and paragraph number.

- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual as specified in Division 01 –General Requirements.
 - .2 Operation and maintenance manual approved by, and final copies deposited with Engineer before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative and Engineer for approval. Submission of individual data will not be accepted.
 - .2 Make changes as required and re-submit as directed by Departmental Representative and Engineer.
 - .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 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.
- .9 As-built drawings:
 - .1 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).
 - .2 Submit to Departmental Representative and Engineer for approval and make corrections as directed.
 - .3 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report in accordance with Division 01 – General Requirement.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Division 01 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 – General 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 Engineer and/or Owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 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, 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 and Engineer.
 - .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 PREPARATION FOR FIRESTOPPING

- .1 Firestopping and Smoke Seals shall be done by each individual contractor. Refer to Section 07 84 00 – Firestopping.
- .2 All Contractors shall use ULC rated system approved for use with the assembly being generated. Contractor to submit detailed shop drawings for each assembly and install as per Manufacturer's installation instructions.

1.11 EXISTING CONDITIONS

- .1 Connect into existing systems at times coordinated with Owner.
- .2 Request written approval 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.

- .5 Relocate and modify existing system as shown on drawings and as required to incorporate existing systems to be re-used into new work as a complete working package at end of Contract. Not all detail may be indicated on drawings. Contractor shall verify existing conditions on-site prior to start of work. Any discrepancies between drawings and existing conditions shall be reported to Engineer for clarification.

1.12 TESTS

- .1 Give 48 h written notice of date for all tests.
- .2 Insulate or conceal work only after testing and approval by Engineer and Commissioning Agent.
- .3 Conduct tests in presence of Engineer and/or Owner's Representative and local authority having jurisdiction where applicable.
- .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.

1.13 ACCESS DOORS

- .1 Access doors shall be supplied and installed by the Mechanical Contractor. Refer to drawings and specification Sections 09 21 16 – Gypsum Board Assemblies and 20 00 20 – Access Doors for Mechanical Systems
- .2 Access doors shall be installed where operating, inspecting, adjusting and servicing to mechanical equipment is required. Coordination between all trades is required on site for determining all the location and sizes required and group components as much as possible to minimize the amount of access doors required.
- .3 Access door shall be 600 x 600 mm minimum for body entry and 300 x 300 mm minimum for hand entry unless otherwise noted.
- .4 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.

1.14 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

- .4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.
- .7 Pipe Sleeves:
 - .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
 - .2 Schedule 40 steel pipe.
 - .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
 - .4 Sizes: minimum 6 mm clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.
 - .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm above other floors.
 - .6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for fire stopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
 - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.

1.15 MAINTENANCE

- .1 Furnish spare parts in accordance with Division 01 –General Requirements as follows:
 - .1 Boiler Spare Parts (For each boiler):
 - .1 Ignitor, Spark w/ Gasket.
 - .2 Gasket, Flame Sensor.

- .3 Gasket set, Burner, Heat Exchanger, Sight Glass – Lower.
 - .4 Gasket, Fan.
 - .5 Condensate Neutralization Kit.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01 –General Requirements.

1.16 DEMONSTRATION, OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Where specified elsewhere in Division 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 4 hour instruction.
- .5 When deemed necessary, Engineer and/or Departmental Representative will record these demonstrations on video tape for future reference.

1.17 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Construction Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 –General Requirements.
 - .2 Store and handle materials in accordance with Construction Plan and Manufacturer’s written instructions

1.18 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 Engineer.
- .3 Where uncertainty exists in the passing of pipes and location of equipment, the general contractor and or project manager 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 Owner.

- .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 Mechanical 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.

1.19 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.
- .2 Where interference exists, this Contractor shall notify the general contractor and/or project manager and the Engineer before installing the work. Any changes in the work or alterations of the Mechanical Contractor's schedule of procedure required for such co-operation will not be considered as a claim for extra compensation.
- .3 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.

1.20 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/she shall refer the matter to the Engineer for change or clarification and shall not proceed with that portion of the work until advised by the Engineer to do so.

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 primer.

Part 3 Execution

3.1 PAINTING AND PRIMER

- .1 All paint and/or primer requirements shall be done in accordance with Section 09 91 00 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Minimum two coats primer over all mechanical supplied frames, brackets, supports and miscellaneous steel.
- .4 Restore to new condition, finishes which have been damaged.

3.2 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

3.3 CLEANING

- .1 Cleaning of mechanical equipment and services shall be done by this contractor.
- .2 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling/roof top unit.

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 GENERAL REQUIREMENTS

- .1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 21 07 16.

1.2 RELATED SECTIONS

- .1 Division 01 – General Requirements.
- .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.3 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.

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Division 01 – General Requirements.

1.5 SAMPLES

- .1 Submit samples in accordance with Division 01 – General Requirements.
- .2 Submit for approval by Engineer: 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.

1.6 MANUFACTURER'S INSTRUCTIONS

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

1.7 QUALIFICATIONS

- .1 Subcontractor responsible for installation to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.8 DELIVERY, STORAGE AND HANDLING

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

1.9 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.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to approved metal recycling facility.

- .5 Divert unused adhesive materials from landfill to official approved hazardous material collections site approved.
- .6 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

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, un-faced:
 - .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 CGSB51-GP-52Ma.
 - .3 Maximum "k" factor: ASTM C612.
- .7 TIAC Code C-2: Mineral fibre blanket unfaced 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 or Air drying 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: to match adjacent finish paint selected by Architect.
 - .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.
 - .8 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
 - .9 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 Architect.
 - .3 Minimum service temperatures: -40°C.
 - .4 Maximum service temperature: 82°C.
 - .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 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, 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.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on both faces of insulation.
- .7 Fasteners: 4 mm diameter pins with 35 mm square clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR VAPOUR RETARDER FINISH

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

2.8 OUTDOOR VAPOUR RETARDER MASTIC

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

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 expansion joints, valves, primary flow measuring elements, flanges, chilled water pumps, and unions at equipment.
- .2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.4 EQUIPMENT INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 Hot equipment:
 - .1 TIAC code A-1 with mechanical fastenings or wire and 13 mm cement reinforced with one layer of reinforcing mesh.
 - .2 Thicknesses:
 - .1 Expansion Tanks: 25 mm Type A-1, PVC jacket.

- .2 Combination air, dirt, hydraulic and magnetic separator: 25 mm Type A-1, PVC jacket.
- .3 Finishes:
 - .1 Equipment in mechanical rooms: TIAC code CEF/1 with aluminum jacket unless specified otherwise.

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 Division 01 – General Requirements.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 – General Requirements. 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 Division 01 – General Requirements.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Division 01 – General Requirements.
- .4 Quality assurance submittals: submit following in accordance with Division 01 – General Requirements:
 - .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, have at least 3 years successful experience in this size and type of project, and be a member of TIAC.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Division 01 – General 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 Division 01 – General Requirements.
 - .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 with factory applied vapour retarder jacket:
 - .1 Mineral fibre: to CAN/CGSB 51.9.
 - .2 Maximum "k" factor: to CAN/CGSB 51.9.
 - .3 Acceptable materials: Fiberglass 850 with all service jacket and double sure closure system, Knauf, Mansville, Manson.
- .4 TIAC Code A 3: Rigid moulded mineral fibre with factory applied vapour barrier jacket and facing material:

- .1 Mineral fibre: to CAN/CGSB 51.9.
- .2 Jacket: to CGSB 51 GP 52 Ma.
- .3 Maximum "k" factor: to CAN/CGSB 51.9.
- .4 Acceptable materials: Fiberglass 850 with all service double sure closure system, vapour barrier jacket and facing material, Knauf, Mansville, Manson.
- .5 TIAC Code A-6: Flexible unicellular tubular elastomer:
 - .1 Insulation: To CAN/CGBS-51.40 with vapour retarder jacket.
 - .2 Jacket: To CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: To CAN/CGSB 51.40.
 - .4 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.
 - .5 Thermal conductivity: 0.039 W/m·°K at 24°C mean temperature per ASTM C 177 or C 518
 - .6 Water vapour permeability: 1.16x10⁻¹⁵ kg/(s·m·Pa) as per ASTM E96.
 - .7 Water absorption: 0.2% per volume per ASTM C209.
 - .8 Flame spread and smoke development: 25/50 per ASTM E84.
 - .9 Temperature range: -57 to 105°C.
 - .10 Acceptable materials: AP Armaflex Pipe Insulation or approved equal.
- .6 TIAC Code C 2: Mineral fibre blanket faced with factory applied vapour retarder jacket:
 - .1 Mineral fibre: to CAN/CGSB 51.11.
 - .2 Jacket: to CGSB 51 GP 52 Ma.
 - .3 Maximum "k" factor: to CAN/CGSB 51.11.
 - .4 Acceptable materials: Fiberglass faced flexible piping insulation Type II with reinforced foil and flame retardant craft facing, Knauf, Mansville, Manson.

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 0.15 mm thick.
 - .8 Jacket must meet or exceed a flame spread rating of 25 and a smoke development rating of 50.
 - .9 Acceptable materials: ITW, Zeston, Proto.
- .2 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50mm sheet.
 - .3 Finish: Smooth.
 - .4 Joining: Longitudinal and circumferential slip joints with 50mm laps.
 - .5 Fittings: 0.5mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19mm wide, 0.5mm thick at 300mm spacing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

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

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with 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 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: To match adjacent pipe jacketing.

3.5 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.
 - .2 Do not insulate exposed run outs to plumbing fixtures, chrome plated piping, valves, fittings.

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 (Supply and Return)		A-1	25	38	38	38	38	38
Domestic Cold Water CWS		A-3	25	25	25	25	25	25
Trap Primer		A-3	25	25	25	25	25	25

- .6 Finishes:
 - .1 Exposed outdoors: Aluminum jacket.
 - .2 Exposed indoors: PVC jacket.
 - .3 Exposed in mechanical rooms: PVC jacket.
 - .4 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .5 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .6 Finish attachments: SS bands at 150 mm on centre.
 - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.
 - .8 Damaged insulation shall be replaced or repaired to TIAC Code recommendations.

3.6 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Division 01 – General 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.

3.7 CLEANING

- .1 Proceed in accordance with Division 01 – General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION