

Part 1 GENERAL

1.1 REGULATORY REQUIREMENTS

- .1 Refer carefully to other parts of the specifications.
- .2 Conform to the requirements and recommendations of all local municipal, provincial and federal codes, by-laws and ordinances.
- .3 Do not reduce the quality of work specified and/or shown on the drawings because of the Regulatory requirements.

1.2 APPLICABLE CODES AND STANDARDS

- .1 In general and as applicable, the physical and chemical properties, the characteristics and the performance of items in this Division shall be as noted in the following:
 - .1 Canadian Standards Association.
 - .2 American National Standards Institute.
 - .3 Provincial Building Code.
 - .4 Civic Building By-Laws.
 - .5 Civic Water Works By-Laws and Sewer By-Laws.
 - .6 Provincial Fire Code.
 - .7 Worker's Compensation Board Requirements.
 - .8 American Society for Testing and Materials.
 - .9 Canadian Government Specifications Board.
 - .10 National Fire Protection Association.
 - .11 Canadian Council of Ministers of the Environment Codes.
 - .12 Underwriters' Laboratories of Canada.

1.3 LATEST EDITIONS

- .1 The latest edition of all codes and standards, of the date of tender submission, shall apply; except for specific editions referenced by overriding codes.

1.4 AUTHORITIES HAVING JURISDICTION (AHJ)

- .1 Comply with all requirements of Authorities with competent jurisdiction, AHJ, including authorized inspectors, without additional compensation.

1.5 PERMITS, FEES AND CERTIFICATES

- .1 In addition to the requirements in Division 01, obtain all required Certificates of Inspection for the work and deliver same to the Engineer before request for substantial performance. These include but are not limited to:

- .1 Equipment start-up reports.
- .2 Fire, smoke, and combination fire/smoke damper test reports.
- .2 Correct installed work as directed by the local Authorized Inspector of the Regulatory body without extra compensation.

1.6 EQUIPMENT LIST

- .1 Compile a complete list of equipment and materials to be used on this project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.
- .2 Submit for review within ten (10) days after award of contract.

1.7 SAFETY FEATURES

- .1 Provide safety features on all equipment to ensure safe operation and maintenance including belt, coupling, and other guards, screened fan intakes and discharges where inadequate ductwork for protection, safety interlocks and labels.

1.8 QUALITY OF MATERIALS

- .1 Furnish new materials, apparatus or products required for the work, of first class quality, delivered, erected, connected up and finished in every detail.
- .2 The use of any or all materials is subject to the approval of the Engineer.
- .3 Unless otherwise specified, all products shall be CSA approved.
- .4 All fire protection materials and products shall be ULC approved.
- .5 If materials, apparatus or products are not CSA or ULC approved, obtain approval of the provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .6 Confirm colours with the Architect before ordering.

1.9 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data for all products and equipment specified must be submitted to the Engineer for review.

- .3 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances (e.g. access door swing spaces).
- .4 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify as to 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 MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.10 COORDINATION

- .1 Coordinate design with other disciplines, taking into account all project requirements.
- .2 Coordinate installation with other trades. To avoid conflicts, early in the project discuss proposed routing of ductwork, piping and locations of equipment with other trades.

1.11 ELECTRICAL WORK

- .1 Mechanical Contractor is responsible for the supply, physical installation, and operation of all electric motors, temperature and humidity controls systems, combustion controls systems, and other electrical devices and systems specified under its portion of the work. Bear full responsibility for factory installed wiring and equipment on packaged equipment, be responsible where detailed in equipment requirements for controlling devices such as, but not restricted to, pump and liquid level controls, multi-speed motor controllers, boiler controls, etc., which are necessarily integrally mounted on packaged equipment.
- .2 Submit detailed composite wiring diagrams for all control systems as specified and as required for the Mechanical work for review by the Engineer. Distribute copies of reviewed drawings to the Electrical Division for their reference.
- .3 Provide all wiring in approved rigid conduit to suit temperature and moisture conditions of area through which wire is to run. All wiring is in accordance with the relevant Electrical Codes, and in no case smaller than #12

AWG. Comply fully with the electrical specifications for all electrical work.

1.12 ELECTRICAL CHARACTERISTICS

- .1 Check with the electrical trade and provide all mechanical items with correct electrical characteristics to suit the electrical work.
- .2 If correct characteristics are not available from the specified equipment manufacturer, contact the Engineer prior to the close of tenders.
- .3 At time of ordering equipment, confirm electrical characteristics with the electrical contractor, and ensure that they have been confirmed with the power authority.
- .4 No additional compensation will be paid for problems arising from incorrect electrical characteristics.

1.13 PAINTING

- .1 Refer to Section 09 91 00 - Painting.
- .2 All paint shall be top quality enamel or as approved by the Engineer, applied in strict accordance with the manufacturer's recommendations and the Engineer's instructions.
- .3 Prime and touch up marred finished paintwork to match original. Unmatched painting is not acceptable.
- .4 Finishes that have been damaged too extensively to be simply primed and touched up shall be restored to new condition and Engineer's satisfaction.
- .5 Be responsible for advising the painter as to the colors and identification of the piping, flow directions, etc.

1.14 CUTTING, PATCHING, REPAIRING, MAKING GOOD

- .1 In addition to the requirements in Division 01, each trade requiring such work shall be responsible for necessary cutting. Patching by appropriate trade. All work to be performed by experienced tradesmen.
- .2 Neatly perform cutting and patching work to blend smoothly with surrounding surfaces.
- .3 Patch and make good disturbed surfaces to match existing adjacent work. Leave finished, neat, to Engineer's approval.
- .4 Perform X-ray examination of wall and floors prior to making openings, where required to avoid damage to structural reinforcements and electrical conduits.

1.15 TESTS

- .1 In addition to the requirements in Division 01, carry out all tests hereinafter noted, as required by the regulatory agencies and as requested by the Engineer and furnish all labour and equipment required for such tests without extra compensation.
- .2 Before activating systems, recheck equipment, check all connections, set all controls for proper start-up, obtain necessary clearances from the electrical division, etc.
- .3 Submit to the Engineer, legible report for all tests conducted, within one week of the test.
- .4 Notify the Engineer at least two (2) working days ahead of all tests, so that the tests can be witnessed on a random basis.

1.16 TRIAL USAGE

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

1.17 CLEANING

- .1 Refer to Section 01 74 11 - Cleaning.
- .2 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

1.18 FUNCTIONAL TESTING

- .1 Test all equipment, devices and systems. Test as required by the AHJ and Engineer, submitting comprehensive reports. Example forms are available from the Engineer.
- .2 Ensure all tests demonstrate compliance with the specified and manufacturers' shop drawing and catalogued performance, as well as compliance with applicable standards.

1.19 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 In addition to the requirements in Division 01, 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.
- .2 Manufacturers, or expert suppliers, to provide demonstrations and instructions.

- .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Engineer or Owner may record these demonstrations on videotape for future reference.
- .6 Submit training schedule and scope description to the Engineer for review and approval for each training topic. Training shall not commence until approval of training schedule and scope if given by the Engineer.

1.20 SPARE PARTS

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals and as follows:
 - .1 One set of filter media/cartridges, for each filter or filter bank in addition to final operating set.
 - .2 One set of belts for each piece of belt-driven equipment.

1.21 SPECIAL TOOLS

- .1 Provide one set of special tools required to service equipment in accordance with Section 01 78 00 - Closeout Submittals and as recommended by manufacturers.

1.22 CLOSEOUT SUBMITTALS

- .1 In addition to the requirements of Section 01 78 00 - Closeout Submittals, provide the following in the Operating and Maintenance Manuals. Edit all general data to specifically apply to this project. Pay particular attention to safety requirements.
- .2 Operation data provided by manufacturer, and to include:
 - .1 Control schematics for each system including environmental controls.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valve schedule and flow diagram.
 - .7 Colour coding chart.
- .3 Maintenance data provided by manufacturer, and shall include:

- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task duration.
- .3 Parts list including model numbers for replacement parts. Include contact name and phone number.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified elsewhere.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Additional data:
 - .1 Prepare and insert additional material into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.
- .6 Submit for review by Engineer, and make final additions and adjustments as directed.

1.23 RECORD DRAWINGS

- .1 Maintain neat record of changes on a set of prints during construction.
- .2 Submit to Department Representative a minimum of five (5) working days before Substantial Completion.
- .3 Contractor shall certify and check the accuracy of each drawing.
- .4 Record additional changes and submit final record drawings at Total Performance.

1.24 SUBSTANTIAL COMPLETION / CERTIFICATION BY ENGINEER / LIFE SAFETY SUBMISSIONS

- .1 Provide minimum notice of ten (10) working days to the Engineer prior to request to declare project substantially complete. Failure to do so may result in site review by Engineer being delayed.
- .2 In addition to the requirements of Division 01 submit the following (as applicable) a minimum of five (5) working days ahead of required proposed date of substantial completion (unless a longer period of time is dictated by Authorities Having Jurisdiction):

- .1 All certificates and documentation required by Authorities Having Jurisdiction.
- .2 Fire and smoke damper test reports.
- .3 Equipment start-up reports.
- .4 Control systems commissioning reports pertaining to equipment/systems required for life safety system operation (i.e. ventilation interlocks/unit operation, CO detection/exhaust systems, etc.).
- .5 Test reports for backflow prevention devices with test taps.
- .6 Written confirmation that propane system is approved by the utility and/or Authority Having Jurisdiction, and turned on.
- .7 Record ('As-Built') drawings.
- .8 Operation and Maintenance Manuals, complete with revisions as directed.
- .9 Written confirmation that all life safety and health systems are fully functional, including but not limited to ventilation, both supply and exhaust.
- .10 Written confirmation that all equipment is operational and under control, indicating exceptions and temporary controls/arrangements.
- .11 All other life safety and health reports and certificates.
- .3 Confirm, in writing, systems are ready for occupancy and use for intended purpose in every respect.
- .4 Before certification date submit detailed written confirmation of completion of deficient life safety work noted in the documentation listed above, including date completed.
- .5 Before certification date submit detailed written confirmation of completion of deficient non-life safety work, including that noted in Engineer reports, listing each deficient item. Submit schedule for completion of all deficient non-life safety work that will not be completed prior to the certification date, listing each deficient item for consideration.
- .6 These requirements apply to each phase of a phased project.

1.25 FAN CONNECTIONS

- .1 Inlet and discharge conditions are critical to proper fan performance. Review proposed fan installations and ensure that proper conditions are provided; add straightening vanes or turning vanes where required.
- .2 In general, provide a minimum of three (3) wheel diameters of straight duct immediately upstream of the fan inlet.

- .3 Review special cases with the Engineer and TAB Contractor prior to installation.
- .4 On transfer fans for offices and meeting rooms, provide acoustic lining on ductwork for sound attenuation.

Part 2 PRODUCTS

2.1 MOTORS

- .1 Motors to be high efficiency, in accordance with local Hydro company standards and the requirements of ASHRAE 90.1.
- .2 Comply with all Canadian Electrical Code requirements, and in particular CSA C22.2 No. 100, c/w CSA label, unless otherwise specified.
- .3 Motors included in the scope of CAN/CSA-C747 shall have a nominal full-load efficiency not less than the minimum specified in that standard. Efficiency ratings of motors included in the scope of this standard shall be based on a statistically valid quality control procedure conforming to the standard. Nameplates shall list the nominal full-load motor efficiency.
- .4 Motors included in the scope of CAN/CSA-C390 shall have a nominal full-load efficiency not less than the minimum specified in that standard. Efficiency ratings of motors included in the scope of this standard shall be based on a statistically valid quality control procedure conforming to the standard. Nameplates shall list the nominal full-load motor efficiency.
- .5 In general, motors are EEMAC Class B (for standard torque applications), 1,800 RPM, continuous duty, open drip proof, ball bearing, 40°C temperature rise above 40°C ambient, 1.15 service factor. Motors are squirrel cage induction unless specifically noted otherwise. Special motors are specified with the equipment driven.
- .6 Single-phase motors shall be equipped with integral thermal overload protection.
- .7 Provide adequate capacity on each motor to operate the associated driven device under all conditions of load and service without overloading and be of at least the power specified.
- .8 Refer to Division 26 and provide motor characteristics within +5% of power source, or get written approval from the Engineer.
- .9 Co-operate with Division 26 during start-up and provide all necessary assistance in commissioning.

- .10 If delivery of specified motor will delay delivery or installation of equipment, install motor approved by Engineer for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

2.2 COUPLING FOR DIRECT DRIVE EQUIPMENT

- .1 Couplings shall be sized such that it will endure an infinite number of starts when equipment is fully loaded. All couplings shall be covered with a removable safety guard.

2.3 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 specified.
- .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 to be 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.

2.4 GUARDS

- .1 Provide guards for all drives as specified and required by Authorities Having Jurisdiction.
- .2 Guards for belt drives (minimum requirements):
 - .1 Expanded galvanized metal screen welded to galvanized steel frame.
 - .2 Minimum 1.2 mm thick galvanized sheet metal tops and bottoms.
 - .3 Prime coat for painting.

- .4 38 mm diameter holes on both shaft centres for insertion of tachometer.
- .5 Allow movement of motors for adjusting belt tension.
- .3 Guards for flexible couplings (minimum requirements):
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Prime coat for painting.
- .4 Guards are to be readily removable to permit servicing of equipment.
- .5 Provide means to permit lubrication and use of test instruments with guards in place.
- .6 Ensure that all guards are securely fastened in place, sufficiently sturdy to provide the required safety and free of rattles and excess vibration.

2.5 FIRE SEPARATION REPAIR

- .1 Refer to Section 07 84 00 – Firestopping.
- .2 Cooperate fully with other trades to ensure maintenance of the rating of fire separations that are penetrated, in strict compliance with the manufacturer's recommendations and requirements of the AHJ.

2.6 ACCESSIBILITY

- .1 Be responsible for supplying and locating all access panels in the ceiling, wall, partitions, etc., where openings are necessary for the inspection, servicing and/or removal of equipment, valves and other items that require periodic access. Panel type to suit the construction of the ceilings, walls, partitions, etc., in which they are located. Determine the location subject to the approval of the Engineer. Access panels to be installed by trade experienced in work with surface in which the panel is to be installed.
- .2 In addition, provide access panels as noted on drawings for existing perimeter radiation covers to permit access to valves without moving furniture.
- .3 Mark mechanical access points in accessible ceilings with distinctive but inconspicuous tags properly attached to the ceiling grid. Obtain sample approval before purchase and installation. Indicate on record drawings.
- .4 Accessibility shall be defined as:
 - .1 Ability to place both hands on equipment or device, with no duct, pipe or other equipment in the way.
 - .2 Must be accessible while standing on maximum 2400 mm high stepladder.

.3 Must be in plain view.

- .5 Mark mechanical access points in accessible ceilings with distinctive but inconspicuous tags properly attached to the ceiling grid. Obtain sample approval before purchase and installation. Indicate on record drawings.

2.7 SLEEVES AND PENETRATIONS

- .1 Install sleeves for all piping passing through floors and walls.
- .2 Sleeves as specifically noted, or through structural walls shall be Schedule 40 steel. All other sleeves are 6 mm galvanized sheet steel.
- .3 Fit sleeves flush on either side of the wall through which they pass, extend sleeves through floors and terminate 50 mm above finished floor. Adjust as necessary to accommodate the requirements of through-penetration fire-stopping systems.
- .4 Where passing through walls, make sleeves a minimum 6 mm clear of the piping, through floors make sleeves a minimum of 20 mm clear of the piping. Pack for full depth with fiberglass insulation & finish with a lagging compound. Penetrations through fire separations shall be repaired to maintain rating.
- .5 Provide escutcheon plates with setscrews to completely cover openings for all exposed pipes passing through walls, subject to the approval of the Engineer. Provide chrome-plated plates in finished areas unless otherwise approved.
- .6 Be responsible for maintaining integrity of building envelope when making penetration to install equipment or devices. Enlist services of qualified trade to make openings in and/or repairs to building envelope.
- .7 Sleeving through steel beams shall be permitted only where approved by the Engineer in writing or where expressly indicated on the Contract Documents. Sleeves are NOT permitted in concrete beams.
- .8 Seal all sleeves to make watertight.

2.8 COUNTER FLASHINGS

- .1 In addition to the requirements in Division 01, provide watertight, non-corroding, counter flashings for all penetrations of the building envelope, painted to match adjacent materials after proper preparation and painting. Refer to drawings, including building drawings, for additional information.

- .2 Installation to allow for movement and accommodate high temperatures where necessary.
- .3 For short pipes, the flashing may overlap the end, in lieu of attachment to the pipe. Minimum 300 mm high above the roof, c/w water break above maximum water level on the roof, to negate wind effects.
- .4 All galvanized material to be 0.7 mm thick minimum.
- .5 In exposed locations, flashings must be aesthetically acceptable to the Engineer.
- .6 Co-ordinate with all other trades including roofer and metal wall panel installer.
- .7 For copper pipe use 0.82 mm sheet copper, soldered to pipe end c/w solder joints.
- .8 For galvanized ducts use galvanized sheet metal soldered to the duct and c/w soldered joints.
- .9 For cast iron and steel pipes at normal temperature, use manufactured stretch fit heavy neoprene flashings c/w galvanized protective layer.
- .10 For hot pipes clamp galvanized to the pipe with a temperature rated gasket and stainless steel worm gear clamp.
- .11 For aluminum and stainless steel, use the same materials for the flashing.
- .12 For manufactured hoods, fans and rooftop unit mounting, apply a low density neoprene gasket all around and fasten securely.

Part 3 EXECUTION

3.1 GENERAL

- .1 All Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Do not scale the Drawings. Consult the Architectural Drawings and details for exact locations of fixtures and equipment; where some are not definitely located, obtain this information from the Engineer.
- .2 Follow Drawings as closely as possible in laying out work and check Drawings of all other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. When headroom or space conditions appear inadequate, notify the Engineer before proceeding with the installation.

- .3 Make reasonable modifications in the layout as needed without extra compensation to prevent conflicts with work of other trades, existing conditions, or for proper execution of the work. This shall include, but not necessarily be confined to, offsets in piping or ducts, transformation in ductwork and relocation of ducts and piping up to 3.0 m either way on each item as required to suit on site job conditions.
- .4 Where variances occur between the Drawings and Specifications or within either document itself, include in the contract, the item or arrangement of better quality, greater quantity, and higher cost or clarify before tenders close. The final decision on the item and manner in which work is installed rests with the Engineer.
- .5 Provide, with all trades involved, marked-up drawings, when requested, of mechanical spaces indicating all dimensions for all installations prior to the work being done. Report any discrepancies to the Engineer. ANY CONFLICTS ARISING THAT MAY HAVE BEEN RESOLVED BY LAYING THE WORK OUT IN THIS MANNER WILL BE RESOLVED WITHOUT ADDITIONAL COMPENSATION.
- .6 Provide 48 hours minimum notice to Engineer and Owner of all work before it is concealed. Expose concealed work for inspection, upon request, when proper notice was not provided and pay all costs therefore, including making good other trades' work.

3.2 SURVEYS AND MEASUREMENTS

- .1 Base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements shown on the Drawings at the site, and check the correctness of same as related to the work.
- .2 Notify the Engineer if any discrepancy is discovered between the actual measurements and those indicated which prevent following good practice or the intent of the Drawings & Specifications. Do not proceed with the work until receiving instructions from the Engineer.

3.3 CO-ORDINATION

- .1 Give full co-operation to those doing work under other Divisions of the specifications and furnish in writing with copies to the Engineer any information necessary to permit the work of all Divisions to be installed satisfactorily and with least possible interference or delay.
- .2 Discuss work with other Divisions prior to installation. Confirm proposed locations for equipment installed by this Division will not interfere with work installed by others.

- .3 If work is installed before coordinating with other trades or so as to interfere with work of other trades, make necessary changes in the work to correct the conditions without extra compensation.
- .4 When requested, provide marked up drawings indicating required clearances for installation of plumbing equipment. Provide section drawings indicating location of other equipment not installed by Mechanical Division, such as other equipment and piping, cable trays, etc. Report any discrepancies to the Engineer.

3.4 ACCESSIBILITY

- .1 Locate all equipment that must be serviced, operated or maintained in fully accessible positions, with minimum interference and maximum usable space. If required for better accessibility, furnish access doors for this purpose. Make deviations from Drawings to allow for good accessibility, obtaining prior approval for changes of magnitude.

3.5 SCAFFOLDING, RIGGING, HOISTING

- .1 Unless otherwise specified, furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment apparatus furnished. Remove same from the premises when no longer required.
- .2 Take precautions not to overload the structure in any manner nor provide inadequate scaffolding and rigging so as to endanger the safety of personnel on the site whether under this Division's employ or otherwise.

3.6 CUTTING AND PATCHING

- .1 Cutting shall be performed neatly by this trade. No hammering or other methods are permitted without approval of the Engineer and other trades affected. Utilize a rebar detector and stud finder to ensure cutting does not damage other elements.
- .2 Patching is to be done by the appropriate trade. Arrange and pay for all patching not specifically specified elsewhere in these specifications, including fire rated patching at fire separations.
- .3 Fill voids around pipes and ducts with fiberglass batt insulation and sheet metal closure strips. For fire separations, install fire stop material in accordance with manufacturer's details as required to meet the UL classification and to match separation rating. Ventilate adequately during curing. Provide adequate structural

support in larger spaces. Install slightly above floors to provide positive drainage away from pipe or duct.

- .4 Provide a structural shop drawing stamped by a Professional Engineer showing all reinforcements required for openings through the structure. Allow for all costs of the reinforcement.

3.7 SUPPORTS

- .1 Provide all necessary and recommended supports for all equipment furnished under this Division. Co-ordinate and facilitate all necessary and recommended foundations, pads, bases and piers provided under other Divisions for equipment furnished or installed under this Division.

3.8 WATERPROOFING

- .1 Obtain approval for the installation method employed where any work pierces waterproofing concrete and waterproofing. Furnish all necessary grout rings sleeves, caulking, curbs, counter flashing and flashing required to make openings through roofs, walls, floors, etc., absolutely watertight. This applies to, but is not restricted to, roof exhausters, relief vents, penthouses, ducts, grilles, pipes, etc. Work involving the roofing is done in conjunction with the roofing Division. Work passing through roofing is to be done in accordance with applicable C.R.C.A. "FL" Series details.

3.9 PROTECTION

- .1 Protect the work and material of all other sections from damage and make good all damage thus caused, to the satisfaction of the Engineer.
- .2 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

3.10 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 All dirt, rubbish, or grease on walls, floors or fixtures for which this Division is responsible must be removed and the premises left in first class condition in every respect.
- .3 Perform cleaning operations in accordance with manufacturer's recommendations.
- .4 Clean all piping and equipment and leave in a condition to receive paint.

- .5 Clean the interior of all ductwork. Ducts 750 x 300 mm and larger shall be vacuumed by hand. Power vacuum ducts smaller than 750 x 300 mm through duct openings, etc.

3.11 EQUIPMENT START-UP

- .1 Mechanical contractor shall ensure that all electrical/mechanical components match and that it is safe to start-up equipment.
- .2 All support such as electrical contractor, controls contractor, etc., shall be arranged by the mechanical and all trades directly involved in equipment being started shall be present for start-up.

3.12 MANUFACTURERS' RECOMMENDATIONS

- .1 Install, adjust, test, start-up, and maintain all equipment in strict accordance with the manufacturer's recommendations. If in conflict with the drawings and specifications, contact the Engineer for clarification.
- .2 Ensure that the manufacturer recommends the product for its intended use. If in doubt, contact the Engineer.

3.13 PERSONNEL PROTECTION

- .1 In addition to the requirements in Division 01, provide visual warning signs and/or markers and mechanical protection devices for all mechanical items mounted below the minimum limits listed below and suspended more than 1500mm clear of the floor.
 - .1 Occupied spaces 2286 mm (7'-6").
 - .2 Service spaces 2133 mm (7'-0").
 - .3 Crawl spaces 1524 mm (5'-0").
- .2 Visual warning devices to be yellow tape with black stripes adhered to the entire perimeter of the item infringing on the occupied space. This will include but not be limited to:
 - .1 Length of pipes or equipment below specified height.
- .3 Mechanical protection devices to be 7 mm ($\frac{1}{4}$ ") wire mesh guard and/or 25 mm thick insulation. This will include but not be limited to:
 - .1 Pipe and equipment hangers.
 - .2 Valves.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials (ASTM International)
 - .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533, Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
 - .7 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .8 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .9 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .10 ASTM C921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CGSB 51-GP-53M, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4 Thermal Insulation Association of Canada (TIAC)
 - .1 National Insulation Standards.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-[M88(R2000)], Surface Burning Characteristics of Building Materials and Assemblies.

1.2 PRODUCT DATA

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

1.3 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.

1.4 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.

1.5 QUALIFICATIONS

- .1 Installer 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.

1.6 DELIVERY, STORAGE AND HANDLING

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

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

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 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.
 - .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.
 - .8 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.
 - .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 Canvas:
 - .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.

.4 Aluminum:

- .1 To ASTM B209.
- .2 Thickness: 0.50 mm sheet.
- .3 Finish: Stucco embossed.
- .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
- .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.5 Stainless steel:

- .1 Type: 304.
- .2 Thickness: 0.25 mm.
- .3 Finish: Stucco embossed.
- .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
- .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

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 diameter 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 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 or C-1 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
 - .2 TIAC code C-2 unfaced with wire or bands and 13 mm cement preceded by one layer of reinforcing mesh.
- .3 Breechings, engine exhausts and mufflers:
 - .1 TIAC code A-2 with 25 mm air gap, mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
- .4 Cold equipment:
 - .1 TIAC A-3 or C-4 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
 - .2 TIAC C-2 faced with vapour retardant jacket and with wire or bands and 13 mm cement preceded by one layer of reinforcing mesh.
 - .3 TIAC A-6 or C-4 with mechanical fastenings or wire or bands.
 - .4 Thicknesses: Chillers (except factory insulated) 50 mm.
- .5 Finishes:
 - .1 Engine exhaust piping and muffler: To TIAC code CRF-4.
 - .2 Equipment in mechanical rooms: TIAC code CEF/1 with jacket.
 - .3 Equipment elsewhere: TIAC code CEF/2 with 13 mm cement jacket.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1, Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings (Including Addenda B, C, D, E, F, G, I and M) (includes supplements).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
 - .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .6 ASTM C921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 1999).
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings

1.2 DEFINITIONS

- .1 For purposes of this section:

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

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

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 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturers' installation instructions in accordance with Section 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, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.7 DELIVERY, STORAGE AND HANDLING

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

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal and Waste Reduction Workplan.

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-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Design to permit periodic removal and re-installation.
- .5 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.
- .6 TIAC Code A-6: Flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.
- .7 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 or Air drying 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: to match adjacent finish paint.
 - .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 ABS Plastic:
 - .1 One-piece moulded type and sheet with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .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 Canvas:
 - .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.
- .4 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Stucco embossed.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .5 Stainless steel:
 - .1 Type: 304.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: Stucco embossed.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to: Section 07 92 10 - Joint Sealing.

Part 3 Execution

3.1 PRE- INSTALLATION REQUIREMENT

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

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be 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.

3.3 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: Aluminum.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

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

3.5 PIPING INSULATION SCHEDULES

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

- .2 TIAC Code: A-1.
 - .1 Securements: SS Wire or Bands at 300 mm oc.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: SS Wire or Bands at 300 mm oc.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Seals: lap seal adhesive, lagging adhesive.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: A-2.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation to be as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Applicat ion	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	up to 59	A-1	25	25	25	25	38	38
Domestic HWS		A-1	25	25	25	38	38	38
Chilled Water	4 - 13	A-3	25	25	25	25	25	25
Refriger ated Drinking Water		A-3	25	25	25	25	25	25
Domestic CWS		A-3	25	25	25	25	25	25
Domestic CWS with vapour retarder		C-2	25	25	25	25	25	25
Refriger ant [hot gas] [liquid]	4 - 13	A-6	25	25	25	25	25	25

Applicat ion	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
[suction]								
Refriger ant [hot gas] [liquid] [suction]	below 4	A-6	25	25	38	38	38	38
Diesel generato r exhaust system		A-2	38	65	65	75	90	90

.8 Finishes:

- .1 Exposed indoors: Aluminum jacket.
- .2 Exposed in mechanical rooms: Aluminum jacket.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoors: Water-proof SS jacket.
- .6 Finish attachments: SS screws or bands, at 150 mm oc.
- .7 Installation: To appropriate TIAC code CRF/1 through CPF/5.

END OF SECTION

Approved: 1999-01-26

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
 - .1 ANSI/NFPA 13- [1997] , Installation of Sprinkler Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 ULC S543- [1984] , Internal Lug Quick Connect Couplings for Fire Hose.

1.2 RELATED SECTIONS

- .1 Section [23 05 21] - [Thermometers and Pressure Gauges - Piping Systems].

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section [01 33 00 - Submittal Procedures] and in accordance with ANSI/NFPA 13, working plans and design requirements.

1.4 SAMPLES

- .1 Submit samples in accordance with Section [01 33 00 - Submittal Procedures].
- .2 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Signs.

1.5 ENGINEERING DESIGN CRITERIA

- .1 Design system in accordance with ANSI/NFPA 13, using following parameters:
 - .1 Hazard:
 - .1 To suit occupancy as indicated.
 - .2 Pipe size and layout:
 - .1 [Hydraulic design] [or] [pipe schedule sizing design] .
 - .2 Sprinkler head layout: to ANSI/NFPA 13 [or as directed by authorities having jurisdiction] .
 - .3 Water supply:
 - .1 Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for bases of design in accordance with ANSI/NFPA 13.

- .2 Base design on ANSI/NFPA 13 and water flow rate of [____] L/s and residual pressure of [____] kPa at [location] .
- .4 Zoning:
 - .1 System zoning as indicated.

1.6 CLOSEOUT SUBMITTALS

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

1.7 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section [01 78 00 - Closeout Submittals].
- .2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

Part 2 Products

2.1 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to ANSI/NFPA 13.
 - .2 Copper tube: to ANSI/NFPA 13.
- .2 Fittings and joints to ANSI/NFPA 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .2 Copper tube: screwed, soldered, brazed.
- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Up to NPS 2: bronze, screwed ends, OS & Y; gate.
 - .3 NPS 2 1/2 and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.
 - .4 Swing check valves.
 - .5 Ball drip.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services.

2.2 SPRINKLER HEADS

- .1 General: to ANSI/NFPA 13 and ULC listed for fire services.

2.3 SPRINKLER HEAD TYPE A

- .1 Upright bronze.

2.4 SPRINKLER HEAD TYPE B

- .1 Pendant chrome link and lever type.

2.5 SPRINKLER HEAD TYPE C

- .1 Pendant chrome glass bulb type.

2.6 SPRINKLER HEAD TYPE D

- .1 Recessed [polished] [satin] [chrome] [glass bulb] [fusible link] type with ring and cup.

2.7 SPRINKLER HEAD TYPE E

- .1 Flush [polished] [satin] [chrome] link and lever type.

2.8 SPRINKLER HEAD TYPE F

- .1 Side wall [polished] [satin] [chrome] link and lever type.

2.9 ALARM CHECK VALVE

- .1 Alarm check valve [with retard chamber] to ANSI/NFPA 13 and ULC listed for fire service.

2.10 SUPERVISORY SWITCHES

- .1 General: to ANSI/NFPA 13 and ULC listed for fire service.
- .2 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
- .4 Pressure alarm switch:
 - .1 With normally open and normally closed contacts and supervisory capability.

2.11 WATER GONG

- .1 To ANSI/NFPA 13 and ULC listed for fire service. Location as indicated.

2.12 FIRE DEPARTMENT CONNECTION

- .1 To ANSI/NFPA 13 and ULC [S543] listed, [siamese] type, location as indicated. Thread specifications to be compatible with local fire department.
- .2 Polished [bronze] [chrome plated] [recessed] [exposed] [with identifying sign cast on plate]. Threaded metal caps and chains.

2.13 EXCESS PRESSURE PUMP

- .1 Pumps: double acting displacement type, open cylinder design, direct drive, ULC listed, complete with relief valve.
- .2 Motor: EEMAC Class B squirrel cage induction 1725 rpm, continuous duty, drip proof, ball bearing, maximum temperature rise 50EC, [0.25] kW, 120/1/60.
- .3 Capacity: [7.6] L/min.
- .4 Pump operation switch: to operate excess pressure pump with pressure differential of [103] kPa.
- .5 Electrical wiring by Division 16.
- .6 Shut-off valve and strainer on pump inlet. Relief valve, check valve and shut-off valve on discharge connections.

2.14 PRESSURE GAUGES

- .1 ULC listed and to Section [23 05 21 - Thermometers and Pressure Gauges - Piping Systems].
- .2 Shall have maximum limit of not less than twice normal working pressure at point where installed.

2.15 SIGNS

- .1 [Bilingual] Signs for control drain and test valves: to ANSI/NFPA 13.

2.16 ANTIFREEZE

- .1 Antifreeze loops to ANSI/NFPA 13, locations as indicated.

2.17 SPARE PARTS CABINET

- .1 For storage of maintenance materials, spare sprinkler heads and special tools.
- .2 Construct to sprinkler head manufacturer's standard.

Part 3 Execution

3.1 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13.
- .2 Install excess pressure pump across alarm valve in accordance with manufacturer's instructions.
- .3 Testing to be witnessed by [Fire Commissioner of Canada] [Canadian Forces Fire Marshal] [authority having jurisdiction] .
- .4 Install water gong as indicated.

Project No.:
R.056754.002

WET PIPE SPRINKLER SYSTEMS

Section 21 13 13
Page 5

END OF SECTION

Approved: 1999-01-26

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA13-[1989], Installation of Sprinkler Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 ULC S543-[1984], Internal Lug Quick Connect Coupling for Fire Hose.

1.2 RELATED SECTIONS

- .1 Section [23 05 21] - [Thermometers and Pressure Gauges - Piping Systems].

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section [01 33 00 - Submittal Procedures] and in accordance with ANSI/NFPA 13.

1.4 SAMPLES

- .1 Submit samples in accordance with Section [01 33 00 - Submittal Procedures].
- .2 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Signs and valve tags.

1.5 ENGINEERING DESIGN CRITERIA

- .1 Design system in accordance with ANSI/NFPA 13, using following parameters:
 - .1 Hazard:
 - .1 To suit occupancy as indicated.
 - .2 Pipe size and layout:
 - .1 [Hydraulic design] [or] [pipe schedule sizing design].
 - .2 Sprinkler head layout: to ANSI/NFPA 13 [or as directed by authority having jurisdiction].
 - .3 Water supply:
 - .1 Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for bases of design in accordance with ANSI/NFPA 13.

- .2 Base design on ANSI/NFPA13 and water flow rate of [____] L/s and residual pressure of [____] kPa at [location].
- .4 Zoning:
 - .1 System zoning as indicated.

1.6 CLOSEOUT SUBMITTALS

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

1.7 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section [01 78 00 - Closeout Submittals].
- .2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

Part 2 Products

2.1 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to ANSI/NFPA 13.
 - .2 Copper tube: to ANSI/NFPA 13.
- .2 Fittings and joints to ANSI/NFPA 13:
 - .1 Ferrous: [screwed,] [welded,] [flanged] [or] [roll grooved].
 - .2 Copper tube: [screwed,] [soldered,] [brazed].
- .3 Auxiliary valves:
 - .1 ULC listed for fire protection service.
 - .2 Up to NPS 2: bronze, screwed ends, OS & Y gate.
 - .3 NPS 2 1/2 and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.
 - .4 Swing check valves.
 - .5 Ball drip.
 - .6 Tamper devices wired back to fire alarm panel.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services.

2.2 SPRINKLER HEADS

- .1 General: to ANSI/NFPA 13 and ULC listed for fire services.

2.3 SPRINKLER HEAD TYPE A

- .1 Upright bronze.

2.4 SPRINKLER HEAD TYPE B

- .1 Pendant chrome link and lever type.

2.5 SPRINKLER HEAD TYPE C

- .1 Pendant chrome glass bulb type.

2.6 SPRINKLER HEAD TYPE D

- .1 Recessed [polished] [satin] [chrome] [glass bulb] [fusible link]type with ring and cup.

2.7 SPRINKLER HEAD TYPE E

- .1 Flush [polished] [satin] [chrome] link and lever type.

2.8 SPRINKLER HEAD TYPE F

- .1 Side wall [polished] [satin] [chrome] link and lever type.

2.9 AUXILIARY SUPERVISORY SWITCHES

- .1 General: to ANSI/NFPA 13 and ULC listed for fire service.
- .2 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
- .4 Pressure alarm switch:
 - .1 With normally open and normally closed contacts and supervisory capability.

2.10 WATER GONG

- .1 To ANSI/NFPA 13 and ULC listed for fire service. Location as indicated.

2.11 FIRE DEPARTMENT CONNECTION

- .1 To ANSI/NFPA 13 and ULC listed, [siamese] type, location as indicated. Thread specifications to be compatible with local fire department.
- .2 Polished [bronze] [chrome plated] [recessed] [exposed] [with identifying sign cast on plate]. Threaded metal caps and chains.

2.12 DRY PIPE VALVE

- .1 ULC listed.
- .2 Cast iron, flanged type, sized to suit water main.

.3 Components:

- .1 Accelerator.
- .2 Air maintenance device with low pressure alarm.
- .3 Alarm pressure switch with supervisory capability.
- .4 Pressure gauges.
- .5 Drain valve.
- .6 Test valve with associated piping.
- .7 Shut off valve - OS & Y with tamper-proof device wired back to fire alarm panel.

2.13 [PRE ACTION] [DELUGE] ALARM VALVE

- .1 ULC listed.
- .2 Cast iron, flanged type, sized to suit water main.
- .3 Components:
 - .1 Accelerator.
 - .2 [Air maintenance device with low pressure alarm.]
 - .3 Alarm pressure switch with supervisory capability.
 - .4 [Test valve and associated piping.]
 - .5 Drain valve.
 - .6 Electrical tripping device.
 - .7 Shut off valve - OS & Y with tamper-proof device wired back to fire alarm panel.

2.14 COMPRESSED AIR SUPPLY

- .1 Automatic Air Compressor.
- .2 ULC listed.
- .3 Capacity:
 - .1 To restore normal air pressure in the system within [30 min] [60 min for low differential systems].
 - .2 To provide air pressure [of 140 kPa in excess of calculated trip pressure of dry pipe valve] [in accordance with instruction sheet furnished with dry pipe valve].
- .4 Piping: ferrous, NPS 3/4 screwed joints and fittings, to ANSI/NFPA 13.

2.15 NITROGEN

- .1 General
 - .1 Introduce Nitrogen to system through pressure regulator set to maintain system pressure.
- .2 Storage containers:
 - .1 Floor mounted anchored to wall.

- .2 [Location as indicated].
- .3 [One bank for initial use and one bank to be connected in reserve].
- .4 Piping: ferrous NPS 3/4 screwed, welded fittings to ANSI/NFPA 13.
- .5 Provide:
 - .1 Visual indication of status of nitrogen supply.
 - .2 Pressure switch for indication of discharge of container to show at main fire alarm panel.
 - .3 Common header.
 - .4 [Directional flow valves].

2.16 PRESSURE GAUGES

- .1 ULC listed and to Section [23 05 21 - Thermometers and Pressure Gauges - Piping Systems].
- .2 Shall have maximum limit of not less than twice normal working pressure at point where installed.

2.17 RELIEF VALVE

- .1 ULC listed.

2.18 SPARE PARTS CABINET

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

Part 3 Execution

3.1 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13.
- .2 Testing to be witnessed by [Fire Commissioner of Canada] [Canadian Forces Fire Marshal] [authority having jurisdiction].
- .3 Install water gong as indicated.
- .4 Install fire department connection[s] as indicated.
- .5 Install spare parts cabinet as indicated.
- .6 Pressure gauges:
 - .1 Location
 - .1 On water side and [air] [nitrogen] side of dry pipe valve.
 - .2 At air receiver.

- .3 In each independent pipe from air supply to dry pipe valve.
- .4 At exhausters and accelerators.
- .2 Install to permit removal.
- .3 Locate so as not subjected to freezing.
- .7 Valve identification:
 - .1 Identify drain valve, by-pass valves and main shut-off valve and all auxiliary valves.

END OF SECTION