
Archambault Institution – Finishing Kitchen

Saint-Anne-des-Plaines, QC

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SPECIFICATIONS - ISSUED FOR TENDER

PART 2 OF 2

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ARCHITECTURE – DFS INC.



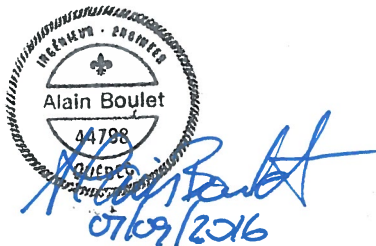
STRUCTURE – SDK et associés



MECHANICAL – PAGEAU MOREL et associés inc.



ELECTRICITY - PAGEAU MOREL et associés inc.



FOOD SERVICES – BERNARD et associés



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SECTIONS AND DETAILS

END OF SECTION

Part 1 General**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 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.
 - .4 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.

1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 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.
- .3 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.
- .4 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.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 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 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.
- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

- .3 Submit to Departmental Representative for approval and make corrections as directed.
- .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 NOT APPLICABLE****Part 3 Execution****3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

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

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL 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 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION

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

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.7 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 REFERENCES

- .1 National Fire Prevention Association (NFPA)
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN4 S543-M984, Standard for Internal Lug Quick Connect Couplings for Fire Hose.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of anchorage
 - .4 Number of anchors.
 - .5 Supports.
 - .6 Reinforcement.
 - .7 Assembly details.
 - .8 Accessories.
- .4 Samples:
 - .1 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Signs.
- .5 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

- .6 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
- .8 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Manufacturer's Catalog Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Alarm valves.
 - .3 Valves, including gate, check, and globe.
 - .4 Water motor alarms.
 - .5 Sprinkler heads.
 - .6 Pipe hangers and supports.
 - .7 Pressure or flow switch.
 - .8 Fire department connections.
 - .9 Excess pressure pump.
 - .10 Mechanical couplings.
- .3 Drawings:
 - .1 Sprinkler heads and piping system layout.
 - .1 Prepare detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
 - .2 Show data essential for proper installation of each system.
 - .3 Show details, plan view, elevations, and sections of systems supply and piping.
 - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.
 - .2 Electrical wiring diagrams.
- .4 Design Data:
 - .1 Calculations of sprinkler system design.
 - .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.

- .5 Field Test Reports:
 - .1 Preliminary tests on piping system.
- .6 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
 - .2 Submit drawings on reproducible Mylar film with title block similar to full size contract drawings.
- .7 Operation and Maintenance Manuals:
 - .1 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in wet sprinkler systems with documented experience.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide spare sprinklers and tools in accordance with NFPA 13.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area.
- .2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.
- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .6 Design systems for earthquake protection for buildings in seismic zones 3 and 4, and only essential and high risk buildings in seismic zone 2.
- .7 Location of Sprinkler Heads:
 - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 for ordinary hazard occupancy group 1.
 - .2 Uniformly space sprinklers on branch.
- .8 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
 - .2 Discharge from individual heads in hydraulically most remote area to be 100 % of specified density.
- .9 Density of Application of Water:
 - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
 - .2 Application to horizontal surfaces below sprinklers shall be 6.12 lpm per m².
- .10 Sprinkler Discharge Area:
 - .1 Area: hydraulically most remote 139 m² area as defined in NFPA 13.
- .11 Outside Hose Allowances:
 - .1 Include allowance in hydraulic calculations for outside hose streams.

.12 Friction Losses:

- .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.

.13 Water Supply:

- .1 A pressure test in accordance with NFPA 291 must be performed outside of the building « U » as soon as the Departmental Representative will endorse it. Thereafter, the hydraulic calculations should be based on the results of the pressure test results.

2.2 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will be permitted.
- .3 Conceal piping in areas with suspended ceiling.

2.3 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA 13.
 - .2 Copper tube: to NFPA 13.
- .2 Fittings and joints to NFPA 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Copper tube: screwed, soldered, brazed, grooved.
 - .3 Provide threaded fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
 - .4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will be permitted.
 - .5 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
 - .6 Fittings: ULC approved for use in wet pipe sprinkler systems.
 - .7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
 - .8 Side outlet tees using rubber gasketed fittings are permitted.
 - .9 Sprinkler pipe and fittings: metal.

- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Gate valves: open by counterclockwise rotation.
 - .3 Provide check valve in piping protecting.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services in accordance with NFPA.

2.4 SPRINKLER HEADS

- .1 General: to NFPA 13 and ULC listed for fire services.
- .2 Sprinkler Head Type: as shown on drawings.
- .3 Provide nominal 1.2 cm orifice sprinkler heads.
 - .1 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.
 - .2 Ceiling plates: not more than 25 mm deep.
 - .3 Ceiling cups: not permitted.

2.5 ALARM CHECK VALVE

- .1 Alarm check valve to NFPA 13 and ULC listed for fire service.
- .2 Provide variable pressure type alarm valve complete with alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories for proper operation of system.
- .3 Provide valve complete with internal components that are replaceable without removing the valve from the installed position.

2.6 SUPERVISORY SWITCHES

- .1 General: to 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 Pressure or flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
 - .2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.
 - .3 Connect into building fire alarm system.
 - .4 Connection of switch: Section 28 31 00.01 - Multiplex Fire Alarm System.
 - .5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.

- .4 Pressure alarm switch:
 - .1 With normally open and normally closed contacts and supervisory capability.

2.7 PRESSURE GAUGES

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

2.8 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through walls.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
 - .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

2.9 ESCUTCHEON PLATES

- .1 Provide metal plates for piping passing through walls in exposed spaces.
- .2 Provide polished stainless steel plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.10 INSPECTOR'S TEST CONNECTION

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.11 SIGNS

- .1 Attach properly lettered Bilingual and approved metal signs to each valve and alarm device to NFPA 13.
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

2.12 SPARE PARTS CABINET

- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

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 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

3.4 ELECTRICAL CONNECTIONS

- .1 Provide electrical work associated with this section under Section 26 05 00 - Common Work Results for Electrical.
- .2 Provide fire alarm system under Section 28 31 00.01 - Multiplex Fire Alarm System.
- .3 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.
- .4 Provide wiring in rigid metal conduit or intermediate metal conduit.

3.5 DISINFECTION

- .1 Disinfect new piping.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.6 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

- .1 Notify Contracting Officer in writing at least 15 days prior to connection date.
- .2 Bolt sleeves around main piping.
- .3 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.
- .4 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

3.7 FIELD PAINTING

- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.
- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.
- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
- .8 Provide primed surfaces with following:
 - .1 Piping in Finished Areas:
 - .1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.
 - .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
 - .3 Provide piping with self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.

- .2 Piping in Unfinished Areas:
 - .1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in spaces above suspended ceilings.
 - .2 Provide piping with self-adhering red plastic bands spaced at maximum of 6 m intervals.

3.8 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
 - .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
 - .2 Test, inspect, and approve piping before covering or concealing.
 - .3 Preliminary Tests:
 - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
 - .2 Flush piping with potable water in accordance with NFPA 13.
 - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
 - .4 Test alarms and other devices.
 - .4 Formal Tests and Inspections:
 - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
 - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
 - .3 Repeat required tests as directed.
 - .4 Correct defects and make additional tests until systems comply with contract requirements.
 - .5 Furnish equipment, instruments, connecting devices, personnel for tests.
 - .6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.
- .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 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

- .3 Site Tests:
 - .1 Testing to be witnessed by authority having jurisdiction.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 ASTM International Inc.
 - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A536, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67, Butterfly Valves.
 - .2 MSS-SP-70, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC)/Institute for Research in Construction
 - .1 NRCC 38728, National Plumbing Code of Canada (NPC).

- .9 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.
- .2 PEX tubing, water pipe for trap primer to be buried.
 - .1 Meets CSA- B137.5, ASTM F876, ASTM F877 and ANSI / NSF 61.
 - .2 Designed for an operating pressure of 690 kPa (100 psi) at 82 °C (180 °F) and 1100 kPa (160 psi) at 23 °C (73 °F).
 - .3 Equipped with a liner for protection against UV rays.
 - .4 Maximum axial thermal expansion of 34 mm/5.56 °C/30.48 m (1.35 inches/10 °F/100 ft).
 - .5 Flame spread index of 25 or less.
 - .6 Smoke spread index of 50 or less.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

- .5 NPS 2 and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1½ and smaller : wrought copper to ANSI/ASME B16.22 or cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.

2.5 GLOBE VALVES

- .1 NPS2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01 - Valves - Bronze.

2.6 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

2.7 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with NPC.
- .2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.3 VALVES

- .1 Isolate equipment, fixtures and branches with gate or ball valves.

- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.4 PRESSURE TESTS

- .1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

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

3.6 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that air chambers, expansion compensators are installed properly.

3.7 DISINFECTION

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

3.8 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
 - .4 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .4 Sterilize HWS and HWC systems for Legionella control.
 - .5 Verify performance of temperature controls.
 - .6 Verify compliance with safety and health requirements.
 - .7 Check for proper operation of water hammer arrestors. Run [one] outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.10 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

3.11 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 ASTM International Inc.
 - .1 ASTM B32, Standard Specification for Solder Metal.
 - .2 ASTM B306, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67, Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125.3, Plumbing Fittings.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36, Commercial Adhesives.
- .4 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products**2.1 COPPER TUBE AND FITTINGS**

- .1 Above ground sanitary and vent, Type DWV to: ASTM B306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.3.

.2 Wrought copper: to CAN/CSA-B125.3.

.2 Solder: tin-lead, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating.

.1 Joints:

.1 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.

.2 Hub and spigot:

.1 Caulking lead: to CSA B67.

.2 Cold caulking compounds.

.2 Above ground sanitary and vent: to CAN/CSA-B70.

.1 Joints:

.1 Hub and spigot:

.1 Caulking lead: to CSA B67.

.2 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

3.3 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

- .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (sanitary and vent,) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 ASTM International Inc.
 - .1 ASTM D2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-Series B1800, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.

Part 2 Products**2.1 PIPING AND FITTINGS**

- .1 For buried DWV piping to:
 - .1 CAN/CSA B1800.

2.2 JOINTS

- .1 Solvent weld for PVC: to ASTM D2564.
- .2 Solvent weld for ABS: to ASTM D2235.

Part 3 Execution**3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with National Plumbing Code.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 ASTM International
 - .1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
 - .1 ANSI/AWWA C700, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
 - .2 ANSI/AWWA C701, Standard for Cold Water Meters-Turbine Type for Customer Service.
 - .3 ANSI/AWWA C702, Standard for Cold Water Meters-Compound Type.
- .3 CSA International
 - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79, Commercial and Residential Drains and Cleanouts.
 - .3 CAN/CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP).
 - .1 IPMVP Version.
- .5 Plumbing and Drainage Institute (PDI)
 - .1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
 - .2 PDI-WH201, Water Hammer Arresters Standard.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.

- .2 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect plumbing materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 FLOOR DRAINS**

- .1 Floor Drains and Trench Drains: to CSA B79.
- .2 Type AS-1: general duty; cast iron body round, adjustable head, 102 mm diameter, sediment basket nickel bronze strainer, trap primer connection, integral seepage pan, and clamping collar.
- .3 Type ASE-1: combination funnel floor drain; cast iron body with integral seepage pan, trap primer connection, clamping collar, nickel-bronze adjustable head strainer, 102 mm diameter, with integral funnel.

2.2 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
 - .1 Wall Access: face or wall type, stainless steel square or round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: rectangular or round cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: nickel bronze, round or square, gasket, vandal-proof screws.
 - .3 Cover for Terrazzo Finish: polished brass with recessed cover for filling with terrazzo, vandal-proof locking screws.
 - .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

2.3 WATER HAMMER ARRESTORS

- .1 Stainless steel construction, piston type: to PDI-WH201.

2.4 BACK FLOW PREVENTERS

- .1 Preventers: to CSA-B64 Series, application as indicated, reduced pressure principle type.

2.5 VACUUM BREAKERS

- .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric hose connection.
- .2 Every coffee machine, ice machine, water cooler and dishwasher must be equipped with a vacuum breaker.

2.6 BACKWATER VALVES

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

2.7 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.8 TRAP SEAL PRIMERS

- .1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

2.9 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
- .3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.10 GREASE INTERCEPTORS

- .1 Grease interceptor, tested and rated in accordance with PDI G101 and CSA B481, complete with acid resistant interior enamel finish for mounting flush with floor with non-skid covers complete with flow control fitting suitably vented. Include a removable baffle, reinforced galvanized steel cover and an extension of 575 mm (dimension to be confirm on the field).
- .2 Capacity: 272 kg and 1136 L.
- .3 Include a siphoning connection of 75 mm.
- .4 Coupling of 150 mm for the inlet and outlet connections.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialties and accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 WATER HAMMER ARRESTORS

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

3.6 BACK FLOW PREVENTERS

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
 - .1 Drains.
 - .2 Backwater Valves.
 - .3 Water Make-up Assembly.
 - .4 Grease Interceptors.
- .2 Pipe discharge to terminate over nearest drain.

3.7 BACKWATER VALVES

- .1 Install in main sewer lines where indicated.
- .2 Install in access pit as indicated.

3.8 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.9 TRAP SEAL PRIMERS

- .1 Install for floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Departmental Representative.
- .3 Install soft copper tubing to floor drain.

3.10 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.11 GREASE INTERCEPTORS

- .1 Install with sufficient space, as indicated, for maintenance.

3.12 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

3.13 TESTING AND ADJUSTING

- .1 General:
 - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13- General Commissioning (Cx) Requirements : General Requirements, supplemented as specified.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
 - .2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
 - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removability of strainer.
 - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.

- .7 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .8 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .9 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .10 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.
- .11 Grease interceptors:
 - .1 Activate, using manufacturer's recommended procedures and materials.
- .12 Hose bibbs, sediment faucets:
 - .1 Verify that flow and pressure meet design criteria.
 - .2 Check for leaks, replace compression washer if required.

3.14 CLOSEOUT ACTIVITIES

- .1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.
- .2 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified.

3.15 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.16 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA Group
 - .1 CAN/CSA-B45, Plumbing Fixtures, (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9).
 - .2 CSA B125.3, Plumbing Fittings.
 - .3 CSA B651, Accessible Design for the Built Environment.
- .2 Green Seal (GS)
 - .1 GS-36, Adhesives for Commercial Use.
- .3 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for washroom fixtures and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
 - .2 Factory-set water consumption per flush at recommended pressure.
 - .3 For water closets, urinals: minimum pressure required for flushing.

1.3 CLOSEOUT SUBMITTALS

- .1 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials indoors off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CSA B125.3.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: [as indicated].
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 Water closets:
 - .1 CA-1 : floor mounted, flush valve.
 - .1 Bowl: vitreous china, syphon jet and elongated rim.
 - .2 Flush valve: TPE membrane, oscillating handle with shut-off, 6 l flush and vacuum breaker.
 - .3 Seat: elongated, solid molded plastic and stainless steel hinge.
 - .2 CA-2 : Wall mounted, concealed flush valve and rear evacuation.
 - .1 Bowl: vitreous china, syphon jet, elongated rim and rear evacuation and alimentation.
 - .2 Concealed flush valve: TPE membrane, chrome push-button of 76 mm, 4.8 l flush with vacuum breaker, concealed components with brass finish and apparent components with chrome finish.
 - .3 Access panel: stainless steel, 14 gauge, 330 x 432 mm, predrilled for push-button and screw vandal proof.
 - .4 Seat: elongated, solid molded plastic and stainless steel hinge.
 - .5 Support/stabilizer: for the flush valve pipe.
- .8 Urinals:
 - .1 UR-1 : wall mounted
 - .1 Urinal: vitreous china, washout type, integral flushing rim, extended shields, integral trap, removable stainless steel strainer and rear evacuation.
 - .2 Concealed flush valve: TPE membrane, chrome push-button of 76 mm, 4.8 l flush with vacuum breaker, concealed components with brass finish and apparent components with chrome finish.

- .3 Access panel: stainless steel, 14 gauge, 330 x 432 mm, predrilled for push-button and screw vandal proof.
- .9 Lavatories:
 - .1 L-1 : Countertop lavatory:
 - .1 Bowl: vitreous china, 521 x 438 mm self-rimming with front overflow and 3 holes.
 - .2 Faucet: slow-closing faucet with push-button, 10 seconds preset cycle, cast brass body, including a thermostatic mixing valve complying to CSA, ASSE1016 and ASSE 1070.
 - .2 L-2 : Wall mounted lavatory:
 - .1 Bowl: vitreous china, 584 x 514 mm, wall hung lavatory with concealed arm carrier system, 3 holes, hidden p-trap including the concealed arm system.
 - .2 Faucet: slow-closing faucet with push-button, 10 seconds preset cycle, cast brass body, including a thermostatic mixing valve complying to CSA, ASSE1016 and ASSE 1070.
 - .3 L-3: wall mounted heavy duty lavatory.
 - .1 Bowl: stainless steel, 14 gauge, 381 x 457 mm, seamlessly welded to form a one piece, vandal resistant unit including angle braces and concealed arm system.
 - .2 Faucet: slow-closing faucet with push-button, 10 seconds preset cycle, cast brass body, including a thermostatic mixing valve complying to CSA, ASSE1016 and ASSE 1070.
- .10 Fixture piping:
 - .1 Hot and cold water supplies to fixtures:
 - .1 Chrome plated flexible, rigid supply pipes with screwdriver stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with clean out on fixtures not having integral trap.
 - .2 Chrome plated in exposed places.
- .11 Chair carriers:
 - .1 Factory manufactured floor-mounted carrier systems for wall-mounted fixtures.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for washroom fixtures installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to manufacturer's recommendations.
 - .2 Wall-hung fixtures: as indicated.
 - .3 Barrier-free: to most stringent CSA B651 NBC.

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.
 - .4 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.
- .3 Checks:
 - .1 Water closets, urinals: flushing action.
 - .2 Aerators: operation, cleanliness.
 - .3 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-B45 Series, Plumbing Fixtures.
 - .2 CAN/CSA-B125.3, Plumbing Fittings.
 - .3 CAN/CSA-B651, Accessible Design for the Built Environment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures to be product of one manufacturer.
- .6 Trim to be product of one manufacturer.

- .7 Mop sinks:
 - .1 Sink CU-1: 316 stainless steel, 16 gauge, including two stainless steel backsplash panel of 300 mm, dimensions of 610 mm x 610 mm x 254 mm.
 - .2 Faucet: integrated vacuum breaker, 1400 mm of rubber hose, including concealed pneumatic valve, hot and cold water activated by push button for prison.
 - .3 Include an access door, 14 gauge stainless steel, 331 x 457 mm, screw vandal proof.

Part 3 Execution**3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as indicated, measured from finished floor.
 - .3 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA-B651.

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
 - .3 Wash fountains: operation of flow-actuating devices.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 Air-Conditioning and Refrigeration Institute (ARI)
 - .1 ARI 1010, Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-B45 Series, CSA Standards on Plumbing Fixtures.
 - .2 CAN/CSA-B125.3, Plumbing Fittings.
 - .3 CAN/CSA-B651, Accessible Design for the Built Environment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for fountains and coolers, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Indicate, for all fixtures:
 - .1 Dimensions, construction details, roughing-in dimensions.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products**2.1 MANUFACTURED UNITS**

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Drinking fountains:
 - .1 F-1 : stainless steel drinking fountain, 18 gauge, stainless steel access panel, push-button, bottom stainless steel panel and wall mounted support.
- .6 Fixture piping:
 - .1 Hot and cold water supplies to each fixture:
 - .1 Chrome plated rigid supply pipes each with screwdriver stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with cleanout on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.
- .7 Chair carriers:
 - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

Part 3 Execution**3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as indicated, measured from finished floor.
 - .3 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this Section.

- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust water cooler, drinking fountain flow stream to ensure no spillage.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B139, Installation Code for Oil Burning Equipment.
- .3 National Fire Code of Canada (NFC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
 - .1 Primers in accordance with manufacturer's recommendations for surface conditions.
 - .2 Primer: maximum VOC limit 250 g/L to Standard GS-11.
 - .3 Paints: maximum VOC limit 150 g/L to Standard GS-11.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 CONNECTIONS TO EQUIPMENT

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

3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 DRAINS

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

3.5 AIR VENTS

- .1 Install air vents to CSA B139 at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

- .1 Install pipework to CSA B139.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.

- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI standards.
- .6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion.
- .15 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use gate ball or butterfly valves at branch take-offs for isolating purposes except where specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .16 Check Valves:
 - .1 Install silent check valves on discharge of pumps and as indicated.

3.8**SLEEVES**

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.

- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for firestopping.
 - .2 Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

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

3.10 PREPARATION FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

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

- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in [relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.13 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval by Departmental Representative 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

3.14 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 Electrical motors, drives and guards for mechanical equipment and systems.
 - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province Territory of Canada.

- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .4 Closeout Submittals
 - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products**2.1 GENERAL**

- .1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 1/2 HP : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 600 V, unless otherwise indicated.

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 indicated.
- .3 For motors under 10 HP : standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.4 DRIVE GUARDS

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

Part 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 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

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

3.4 CLEANING

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

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 ASTM International Inc.
 - .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A105/A105M, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Manufacturer, model number, line contents, pressure and temperature rating.
 - .2 Movement handled, axial, lateral, angular and the amounts of each.
 - .3 Nominal size and dimensions including details of construction and assembly.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Data to include:
 - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products**2.1 ANCHORS AND GUIDES**

- .1 Anchors:
 - .1 Provide as indicated.
 - .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.
 - .3 Reinforcement: to Section 03 20 00 - Concrete Reinforcing.
- .2 Alignment guides:
 - .1 Provide as indicated.
 - .2 To accommodate specified thickness of insulation.
 - .3 Vapour barriers, jackets to remain uninterrupted.

Part 3 Execution**3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install expansion joints with cold setting, as indicated. Make record of cold settings.
- .2 Install pipe anchors and guides as indicated. Anchors to withstand 150 % of axial thrust.
- .3 Do welding in accordance with section 23 05 17 - Pipe Welding.

3.3 PIPE CLEANING AND START-UP

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

3.4 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1, Power Piping.
 - .2 ANSI/ASME B31.3, Process Piping.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C206, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
 - .1 AWS C1.1M/C1.1, Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1, Safety in Welding, Cutting and Allied Process.
 - .3 AWS W1, Welding Inspection Handbook..
- .4 Canadian Standards Association (CSA International)
 - .1 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
 - .2 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.
 - .3 CSA-W117.2, Safety in Welding, Cutting and Allied Processes.
 - .4 CSA W178.1, Certification of Welding Inspection Organizations.
 - .5 CSA W178.2, Certification of Welding Inspectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Welders:
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
 - .3 Submit welder's qualifications to Departmental Representative.
 - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
 - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
 - .2 Inspectors:
 - .1 Inspectors qualified to CSA W178.2.

- .3 Certifications:
 - .1 Registration of welding procedures in accordance with CSA B51.
 - .2 Copy of welding procedures available for inspection.
 - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 QUALITY OF WORK

- .1 Welding: in accordance with ANSI/ASME B31.1 and B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
 - .1 Where used, fit to minimize gaps between ring and pipe bore.
 - .2 Do not install at orifice flanges.
- .3 Fittings:
 - .1 NPS 2 and smaller: install welding type sockets.
 - .2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

- .1 General:
 - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual control: inspect every weld on the inner and outer circumference.

3.6 DEFECTS MOTIVATING THE REJECTION OF WELDS

- .1 Complies to ANSI/ASME B31.1 and ANSI/ASME boiler and pressure vessel code.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .3 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP)
 - .1 IPMVP Version.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test and Evaluation Reports:
 - .1 Submit certified test reports for [thermometers and pressure gauges] from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store thermometers and pressure gauges off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 GENERAL**

- .1 Design point to be at mid-point of scale or range.
- .2 Ranges: according pressures and operating temperature.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4 and ASME B40.200.
 - .1 Resistance to shock and vibration.

2.3 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: stainless steel.

2.4 PRESSURE GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
 - .1 Siphon for steam service.
 - .2 Bronze stop cock.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 GENERAL

- .1 Install thermometers and gauges so they can be easily read from floor or platform.
- .2 Install between equipment and first fitting or valve.

3.3 THERMOMETERS

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
 - .1 Water heating coils.
- .3 Install wells for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

- .1 Install in locations as follows:
 - .1 Upstream and downstream of PRV's.
 - .2 Upstream and downstream of control valves.
 - .3 Inlet and outlet of coils.
 - .4 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 PROTECTION

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

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International
 - .1 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B283, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B505/B505M, Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.
 - .2 Submit data for valves specified in this Section.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 Products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: solder ends to ANSI/ASME B16.18.
- .3 Gate Valves:
 - .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B62.
 - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: Handwheel.

- .4 Globe Valves:
 - .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B62.
 - .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: handwheel.
- .5 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .3 NPS 2 and under, vertical lift type, bronze disc, Class 125:
 - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .6 Silent Check Valves:
 - .1 NPS 2 and under:
 - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
 - .2 Pressure rating: [Class 125].
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
 - .4 Disc and seat: renewable rotating disc.
 - .5 Stainless steel spring, heavy duty.
 - .6 Seat: regrindable.

- .7 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62.
 - .2 Pressure rating: Class 125 and 860 kPa steam.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.
- .8 Butterfly Valves:
 - .1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.
 - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
 - .2 Disc: elastomer coated ductile iron with integrally cast stem.
 - .3 Operator: lever.

Part 3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International Inc.
 - .1 ASTM A49, Standard Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM A536, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM B85/B85M, Standard Specification for Aluminum-Alloy Die Castings.
 - .7 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-61, Pressure Testing of Steel Valves.
 - .2 MSS SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP-82, Valve Pressure Testing Methods.
 - .5 MSS SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Canada.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.

Part 2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B209 Class B.
 - .2 Connections: flanged ends plain face grooved ends to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
 - .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

2.2 GATE VALVES

- .1 NPS 2 1/2 - 8, non rising stem, inside screw, iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B62.
 - .3 Seat rings: renewable bronze to ASTM B62, screwed into body.
 - .4 Stem: bronze to ASTM B62.
 - .5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
 - .6 Seat: integral with body.
 - .7 Stem: wrought steel.
 - .8 Operator: handwheel.
 - .9 Bypass: complete with union and NPS globe valve.
- .2 NPS 2 1/2-8, outside screw and yoke (OS Y), iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
 - .3 Seat rings: renewable bronze screwed into body.
 - .4 Stem: nickel-plated steel.
 - .5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
 - .6 Seat rings: integral with body.
 - .7 Stem: nickel-plated steel.
 - .8 Pressure-lubricated operating mechanism.
 - .9 Operator: handwheel.
 - .10 Bypass: complete with union and NPS gate valve as Section 23 05 05 - Installation of Pipework.

2.3 UNDERWRITERS APPROVED GATE VALVE

- .1 NPS 2 1/2 - 14, OS Y:
 - .1 Approvals: UL and FM approved for fire service.
 - .2 UL and FM Label: on valve yoke.
 - .3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC C-262 (B) ductile iron to ASTM A536 Grade 65-45-12.
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
 - .5 Packing gland: bronze.

- .6 Stem: manganese bronze. Diameter to ULC C-262 (B). Brass, ASTM B16.
- .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
- .8 Bosses for bypass valve, drain: on NPS 4 and over.
- .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: EPDM coated cast iron with bronze disc rings.
- .10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.
- .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
 - .2 NPS 14-1.2: 1.2 MPa CWP.
- .12 Operator: handwheel.
- .13 Bypass: complete with union and NPS gate valve as Section 23 05 23.01 - Valves - Bronze.

2.4 GLOBE VALVES

- .1 NPS 2 1/2 - 10, OSY:
 - .1 Body: with multiple-bolted bonnet.
 - .2 WP: 860 kPa steam, 1.4 MPa CWP.
 - .3 Bonnet-yoke gasket: non-asbestos.
 - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
 - .5 Seat ring: renewable, regrindable, screwed into body.
 - .6 Stem: bronze to ASTM B62.
 - .7 Operator: handwheel.
 - .8 Bypass: complete with union and NPS gate valve as Section 23 05 23.01 - Valves - Bronze.

2.5 BYPASSES FOR GATE AND GLOBE VALVES

- .1 Locations: on valves as indicated.
- .2 Size of bypass valve:
 - .1 Main valve up to NPS 8: NPS 3/4.
- .3 Type of bypass valves:
 - .1 On gate valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.
 - .2 On globe valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.

2.6 VALVE OPERATORS

- .1 Install valve operators as follows:
 - .1 Handwheel: on valves except as specified.

2.7 CHECK VALVES

- .1 Swing check valves, Class 125:
 - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A126 Class B.
 - .2 Ratings:
 - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
 - .3 Disc: rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B62.
 - .4 Seat rings: renewable bronze to ASTM B62 screwed into body.
 - .5 Hinge pin, bushings: stainless steel.
 - .6 Disc: A126 Class B, secured to stem, rotating for extended life.
 - .7 Seat: cast iron, integral with body.
 - .8 Hinge pin: exelloy; bushings: malleable iron.
 - .9 Identification tag: fastened to cover.
 - .10 Hinge: stainless steel.

Part 3 Execution

3.1 INSTALLATION

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

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ASME B16, Fittings and Valves Package.
 - .2 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.
 - .3 ANSI/ASME B16.10, Face-to-Face and End-to-End Dimensions Valves.
 - .4 ANSI/ASME B16.25, Buttwelding Ends.
 - .5 ANSI/ASME B16.34, Valves Flanged, Threaded and Welding End. Includes Supplement (2010).
- .2 American Petroleum Institute (API)
 - .1 API STD 598, Valve Inspection and Testing.
- .3 ASTM International
 - .1 ASTM A49, Standard Specification for Heat-Treated Carbon Steel Joint Bars, Micro Alloyed Joint Bars, and Forged Carbon Steel Comprise Joint Bars.
 - .2 ASTM A182/A182M, Standard Specification for Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valve Parts for High Temperature Service.
 - .3 ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
 - .4 ASTM A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.
 - .5 ASTM A216/A216M, Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
 - .6 ASTM B85/B85M, Standard Specification for Aluminum-Alloy Die Castings.
- .4 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP)
 - .1 IPMVP.
- .5 Green Seal Environmental Standards (GS)
 - .1 GS-11, Standard for Paints and Coatings.
 - .2 GS-36, Standard for Commercial Adhesives.

- .6 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
 - .1 MSS SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS SP-61, Pressure Testing of Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for each valve and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for valves for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect valves from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 To be of single manufacturer.
 - .2 Test valves individually.

- .2 Requirements common to valves, unless specified otherwise:
 - .1 Pressure-temperature ratings: to ANSI B16.34.
 - .2 Inspections and tests: to API 598.
 - .3 Pressure testing: to MSS SP-61.
 - .4 Flanged valves:
 - .1 Face-to-face dimensions: to ANSI B16.10.
 - .2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face.
 - .5 Butt-weld valves:
 - .1 End-to-end dimensions: to ANSI B16.10.
 - .2 End dimensions: to ANSI B16.25 bored for [standard pipe schedule].
 - .6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49.
 - .7 Markings: to MSS SP-25.
 - .8 Identification:
 - .1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
 - .2 Body markings: manufacturer, size, primary service rating, material symbol.
 - .9 CRN registration number required for all products.

2.2 GATE VALVES

- .1 NPS 2 1/2 - 12, rising stem, OS Y, solid wedge disc, flanged ends, Class 150:
 - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB, with full length disc guides designed to ensure correct re-assembly.
 - .2 Body/bonnet joint: flat face with corrugated metallic gasket.
 - .3 Bonnet studs: to ASTM A193/A193M Type B7.
 - .4 Bonnet nuts: to ASTM A194/A194M Type 2H.
 - .5 Stuffing box: including non-galling two-piece ball jointed packing gland, with swing-type eye bolts and nuts.
 - .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
 - .7 Yoke sleeve: Ni-Resist, minimum melting point above 954 degrees C.
 - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
 - .9 Disc: with disc stem ring to connect to stem, guided throughout its travel.
 - .1 NPS 2 1/2 - 6: solid corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.
 - .2 NPS 8 and larger: carbon steel faced with corrosion and heat resistant 13 chromium steel with minimum hardness of 350 HB.

- .10 Seat ring: seamless carbon steel with hard-faced cobalt-chromium-tungsten alloy seating surface, slipped in, seal welded, ground to match disc.
- .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut, T-head disc-stem connection.
- .12 Operator: see elsewhere in this Section.

2.3 GLOBE VALVES

- .1 NPS 2 1/2 - 12, rising stem, OS Y, flanged ends, Class 150:
 - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB.
 - .2 Body/bonnet joint: [flat] [male-female] face with corrugated metallic gasket.
 - .3 Bonnet studs: to ASTM A193/A193M Type B7.
 - .4 Bonnet nuts: to ASTM A194/A194M Type 2H.
 - .5 Stuffing box: including non-galling two-piece ball-jointed packing gland, with swing-type eye bolts and nuts.
 - .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
 - .7 Yoke bushing: Ni-Resist, minimum melting point above 954 degrees C.
 - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
 - .9 Disc: [plug type with 15 degrees taper seat and bottom guide] [ball type with 35 degrees taper seat].
 - .10 Seat rings: with 1.6 mm thick cobalt-chromium-tungsten alloy facings with minimum hardness of 375 HB (cold), slipped in, seal welded, ground to match disc.
 - .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with bonnet bushing, long engagement with yoke bushing for accurate seating, accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .12 Operator: see elsewhere in this Section.

2.4 VALVE OPERATORS

- .1 Handwheel: on all valves.
- .2 Motors:
 - .1 Application: full open and full close applications.
 - .2 Position and precision control.

2.5 BYPASSES FOR GATE AND GLOBE VALVES

- .1 Locations: on valves as indicated.
- .2 Size of bypass valve:
 - .1 Main valve up to NPS 8: NPS 3/4.

- .3 Type of bypass valves:
 - .1 On gate valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze.
 - .2 On globe valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze.

2.6 CHECK VALVES

- .1 NPS 2 1/2 and over, flanged or butt-weld ends, Class 150: swing check.
 - .1 Body and multiple-bolted cap: cast steel to ASTM A216/A216M WCB.
 - .2 Cap studs: to ASTM A193/A193M Type B7.
 - .3 Cap nuts: to ASTM A194/A194M Type 2H.
 - .4 Body/cap joint: male-female face with corrugated metallic gasket.
 - .5 Disc: heat treated corrosion and heat resistant 13% chromium steel.
 - .6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.
 - .7 Hinge: ASTM A182/A182M.
 - .8 Hinge pin: ASTM A182/A182M.
 - .9 Hinge pin plugs: ASTM A182/A182M.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.

3.3 COMMISSIONING

- .1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.2M, Pipe Threads, 60 deg. General Purpose (Metric).
 - .2 ASME B16, Fittings and Valves Package.
 - .3 ANSI/ASME B16.1, Grey Iron Pipe Flanges and Flanged Fittings. Classes 25, 125, and 250.
 - .4 ANSI/ASME B16.10, Face-to-Face and End-to-End Dimensions Valves.
 - .5 ANSI/ASME B16.11, Forged Fittings, Socket-Welding and Threaded.
 - .6 ANSI/ASME B16.25, Buttwelding Ends.
 - .7 ANSI/ASME B16.34, Valves Flanged, Threaded and Welding End. Includes Supplement (2010).
- .2 ASTM International
 - .1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Canadian Registration Number (CRN)
- .4 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP)
 - .1 IPMVP.
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-78, Cast Iron Plug Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for each valve and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for valves - lubricated plug for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect valves from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 To be of single manufacturer.
 - .2 Ensure products have CRN registration number.

2.2 ECCENTRIC PLUG VALVES - SCREWED ENDS

- .1 General:
 - .1 Dead-tight shut-off on liquids and gases at pressure differentials up to 1.2 MPa in forward direction, 520 kPa in reverse direction.
- .2 Up to NPS 2, screwed ends:
 - .1 Body: cast iron to ASTM B209 Class B.
 - .2 Plug:
 - .1 NPS 1/2 and 3/4: bronze to ASTM B62.
 - .2 NPS 1 to NPS 2: bronze to ASTM B62.
 - .3 Bearings: permanently lubricated, bronze to ASTM B62 in upper and lower journals.
 - .4 Seals: double-seal consisting of:
 - .1 Plastic seat coating between plug and body.
 - .2 Resilient seal moulded into groove in plug face.

- .3 Seal materials: BUNA stem seals with neoprene plug seals.
- .4 VITON stem seals with fluorinated hydrocarbon plug seals.
- .5 Isobutene isoprene stem seal with isobutene-isoprene plug seals.
- .5 End connections: screwed.
- .6 Operators: lever.
- .3 NPS 2 1/2 to NPS 4, flanged ends:
 - .1 Body: cast iron to ASTM B209 Class B.
 - .2 Plug: nickel-plated cast iron to ANSI.
 - .3 Bearings: permanently lubricated, bronze to ASTM B62 in upper and lower journals.
 - .4 Seals: double-seal consisting of:
 - .1 Plastic seat coating between plug and body.
 - .2 Resilient seal moulded into groove in plug face.
 - .3 Seal materials: BUNA stem seals with neoprene plug seals.
 - .4 VITON stem seals with fluorinated hydrocarbon plug seals.
 - .5 Isobutene isoprene stem seal with isobutene-isoprene plug seals.
 - .5 End connections: roll grooved.
 - .6 Operators: lever.

2.3 LUBRICATED PLUG VALVES

- .1 Principle of operation:
 - .1 Special sealing compound used to effect tight seal. When line pressure applied to valve in closed position, parallel plug forced against downstream side of valve. Metal-to-metal contact and sealing compound ensures leak-tight seal.
- .2 Testing: to MSS SP-78 for non-shock pressure as per manufacturers.
- .3 End connections:
 - .1 NPS to 2: screwed ends.
 - .2 NPS 2 to 12: flanged ends.
- .4 Valve:
 - .1 Body: cast iron to ASTM A126 Class B semi-steel.
 - .2 Pressure rating: NPS to 12:
 - .1 Screwed end valves: screwed to NPT standards.
 - .2 Flanged end valves: flanged to ANSI B16.1 Class 125, 125 psig at 232 degrees C. Flanged valves NPS 2-8 face dimensions in accordance with ANSI B16.10 short pattern, making them interchangeable with Class 125 flanged cast iron gate valves.
 - .3 Hydrostatic tests: body 300 psig. Seat: 100 psig.
 - .3 Plug: cylindrical, with regular, pattern port - 90 degrees from full open to full closed, complete with PTFE thrust ring: 100% full port.

- .4 Number of ports: as indicated.
- .5 Ends: with butt welding to ANSI B16.25.
- .6 Lubrication system, nickel-plated.
- .7 Lubricant: to suit type, temperature and pressure of contained fluid.
- .8 Include sealing compound injection gun designed for use with pre-packed sealing compound cartridges and valve fitted with button head nipples and combination sealing screws.
- .9 Feeding system: lubricant forced into lubrication grooves between seating surfaces of plug and body to form positive seal, leak proof operation, and corrosion preventing film.
 - .1 Ensure lubricant receptacle can hold additional lubricant.
 - .2 Include lubricant screw for lubrication.
 - .3 Include check valve to prevent reverse flow of lubricant.
 - .4 Include O-rings between body and plug.
- .5 Operator:
 - .1 Up to NPS 5: manual lever.
- .6 3-port and 4 port valves:
 - .1 Supply with transflow pattern.
 - .2 Include limit stops.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION OF LUBRICATED PLUG VALVES

- .1 Install with line pressure acting to hold plug against body port.
 - .1 Cut off from higher pressure.

3.3 COMMISSIONING OF LUBRICATED PLUG VALVES

- .1 Determine type of sealing compound for particular application.

- .2 Ensure even distribution of sealing compound and tight shut-off by opening and closing valve 3 times minimum.
- .3 Ensure that plug is free to float when operating valve by easing valve off body.
- .4 Determine frequency of re-lubrication during commissioning of remainder of system.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

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

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1, Power Piping.
- .2 ASTM International
 - .1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.
 - .2 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .5 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products**2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .2 Performance Requirements:
 - .1 Design supports, platforms, catwalks, hangers to withstand seismic events.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut carbon steel retaining clip.
 - .1 Rod: 13 mm FM approved.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed and FM approved MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed and FM approved to MSS SP69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut [UL listed] [FM approved].
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed and FM approved to MSS SP69.
- .5 Hanger rods: threaded rod material to MSS SP58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .6 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.

- .7 Adjustable clevis: material to MSS SP69 UL listed and FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper, glass, brass pipework: epoxy coated , with formed portion plastic coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: black carbon steel to MSS SP58, type 42, UL listed and FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.6 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops..
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.10 PLATFORMS AND CATWALKS

- .1 To Section 05 50 00 - Metal Fabrications.

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 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.

- .3 Steel pipes: install below coupling or shear lugs welded to pipe.
- .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m

- .7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.

- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL 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 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
- .3 National Building Code of Canada (NBC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province Canada.
 - .2 Provide separate shop drawings for each isolated system complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

- .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for 100% relative humidity installations.
- .4 Colour code springs.

2.3 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .3 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

2.4 ROOF CURB ISOLATION RAILS

- .1 General: complete factory assembled.
- .2 Lower member: continuous extruded aluminum channel.

- .3 Upper member: continuous extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.
- .4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.
- .5 High frequency isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly. Material: closed cell neoprene.
- .6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: aluminum.
- .7 Hardware: cadmium plated or galvanized.

2.5 SEISMIC CONTROL MEASURES

- .1 General:
 - .1 The equipment and system must stay operational during an earthquake.
 - .2 Seismic control systems to work in every direction.
 - .3 Fasteners and attachment points to resist same maximum load as seismic restraint.
 - .4 Drilled or power driven anchors and fasteners not permitted.
 - .5 No equipment, equipment supports or mounts to fail before failure of structure.
 - .6 Supports of cast iron or threaded pipe not permitted.
 - .7 Seismic control measures not to interfere with integrity of firestopping.
- .2 Static equipment:
 - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Suspended equipment:
 - .1 Use one or more of following methods [depending upon site conditions] [as indicated]:
 - .1 Install tight to structure.
 - .2 Cross brace in every direction.
 - .3 Brace back to structure.
 - .4 Cable restraint system.
 - .3 Seismic restraints:
 - .1 Cushioning action gentle and steady.
 - .2 Never reach metal-like stiffness.

- .3 Vibration isolated equipment:
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
 - .3 As indicated.
- .4 Piping systems:
 - .1 Fire protection systems: to NFPA 13.
 - .2 Piping systems: hangers longer than 300 mm; brace at each hanger.
 - .3 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing methods:
 - .1 Approved by Departmental Representative.
 - .2 Structural angles or channels.
 - .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

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 INSTALLATION

- .1 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

- .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Twice during the installation, at 25% and 60% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
 - .4 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification:
 - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .2 Take vibration measurements for equipment.
 - .3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
 - .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 REFERENCES

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

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

- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.
- .5 Identification for PWGSC Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
 - .2 Equipment in Mechanical Room:
 - .1 Main identifier: size #9.
 - .2 Source and Destination identifiers: size #6.
 - .3 Terminal cabinets, control panels: size #5.
 - .3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Sprinklers: to NFPA 13.
 - .2 Standpipe and hose systems: to NFPA 14.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.

- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Steam 103 kPa (15 psig)	Yellow	103 kPa (15 psig) STEAM
Steam 861 kPa (125 psig)	Yellow	861 kPa (125 psig) STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Yellow	ST.COND.RET (PUMPED)
Safety valve vent	Yellow	STEAM VENT
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.6 IDENTIFICATION DUCTWORK SYSTEMS

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

2.7 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

- .2 Inscriptions to include function and (where appropriate) fail-safe position.

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 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.3 NAMEPLATES

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

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.6 CLEANING

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

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

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

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

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

1.9 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:

- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5 %, minus 5 %.
 - .2 Hydronic systems: plus or minus 10 %.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

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

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Format in accordance with [referenced standard].
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative]] for verification and approval, in French both official languages in D-ring binders, complete with index tabs.

1.16 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.17 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.18 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of AABC, NEBB, SMACNA and ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified Division 23

- .3 Qualifications: personnel performing TAB current member in good standing of AABC NEBB qualified to standards of AABC and NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC and NEBB.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.19 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.
- .2 Smoke management systems:
 - .1 Test for proper operation of all smoke and fire dampers, sensors, detectors, installed as component parts of air systems specified Division 23.

1.20 POST-OCCUPANCY TAB

- .1 Measure DBT and air velocity, in occupied zone.
- .2 Emergency evacuation: participate in full scale emergency evacuation exercises.
- .3 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

Part 2 Products**2.1 NOT USED****Part 3 Execution****3.1 NOT USED****END OF SECTION**

Part 1 General**1.1 SUMMARY****.1 Section Includes:**

- .1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Air Duct Leakage Test Manual.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format to Departmental Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
 - .2 Prepare report of results and submit to Departmental Representative within 24 hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Manufacturer's field reports specified.

Part 2 Products**2.1 TEST INSTRUMENTS**

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.
- .3 Submit details of test instruments to be used to Departmental Representative at least three months before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.
- .5 Re-calibrated every six months thereafter.

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 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: leakage 2 %.
 - .2 Large low pressure duct systems up to 500 Pa: leakage 2 %.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test when ambient temperature will not affect effectiveness of seals, and gaskets.
- .3 Flexible connections to VAV boxes.

3.5 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services.
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services: 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, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.
- .2 Performance Verification:
 - .1 Departmental Representative to witness tests and to verify reported results.
 - .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

3.6 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 For purposes of this section:

- .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 "EXPOSED" - means "not concealed" as previously defined.
- .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 Reference Standards:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- .1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

- .1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
- .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
- .3 ASTM C411, Standard 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 C547, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .9 ASTM C921, Standard 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.

.4 Green Seal Environmental Standards (GSES)

- .1 Standard GS-36, Commercial Adhesives.

- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .4 Samples:
 - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .2 Mount sample on 12 mm plywood board.
 - .3 Affix typewritten label beneath sample indicating service.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

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

Part 2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .2 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .3 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
 - .1 Maximum VOC limit 50 g/L to GSES GS-36.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .1 Maximum VOC limit 50 g/L to GSES GS-36.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave.

- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
 - .1 Maximum VOC limit 50 g/L to GSES GS-36.
- .8 Canvas adhesive: washable.
 - .1 Maximum VOC limit 50 g/L to GSES GS-36.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution**3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Return and exhaust ducts exposed in space being served	none		
Outside air ducts to mixing plenum	C-1	Yes	25
Mixing plenums	C-1	Yes	25
Supply duct	C-1	Yes	25

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 SUMMARY****.1 Section Includes:**

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

1.2 REFERENCES**.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)**

- .1 ASHRAE Standard 90.1, 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, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411, Standard 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 C533, Calcium Silicate Block and Pipe Thermal Insulation.
- .6 ASTM C547, Mineral Fiber Pipe Insulation.
- .7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .8 ASTM C921, Standard 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) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus)

- .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
- .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, 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
 - .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .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 label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: 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.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.

Part 2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702.
- .5 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: to CAN/ULC-S702 with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC S102.
 - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

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 VAPOUR RETARDER LAP ADHESIVE

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

2.5 INDOOR VAPOUR RETARDER FINISH

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

2.6 OUTDOOR VAPOUR RETARDER FINISH

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

2.7 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: by Departmental Representative.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees 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.
- .2 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.

2.8 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to: Section 07 92 00 - Joint Sealants.

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 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 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 flanges and unions at equipment.
- .2 Design: to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: aluminum or PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

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

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: SS wire bands at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-6.
 - .1 Insulation securements: adhesive for insulation and vapor barrier.
 - .2 Seals: lap seal adhesive, lagging adhesive.
- .4 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Insulation securements: adhesive for insulation and vapor barrier.
 - .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 runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp degrees 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
Steam	up to 175	A-1	38	50	65	75	90	90
Steam, Saturated and Super heated	over 175	A-1	38	65	65	75	90	90
Condensate Return	60 - 94	A-1	25	38	38	38	38	38
Vapor Vent	60 - 94	A-1	25	38	38	38	38	38
Domestic HWS	A-1	25	25	25	38	38	38	
Recirculated Water	A-1	25	25	25	38	38	38	38
Domestic CWS with vapour retarder	C-2	25	25	25	25	25	25	
Refrigerant	4 - 13	A-6	25	25	25	25	25	25
Refrigerant	below 4	A-6	25	25	38	38	38	38

.6 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Outdoors: water-proof aluminum jacket.

.6 Finish attachments: SS bands, at 150 mm on centre. Seals: wing.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

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

1.3 STEAM SYSTEMS

- .1 Performance verification:
 - .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
 - .2 Verify operation of components of steam system including:
 - .1 Steam traps by:
 - .1 Measuring temperature of condensate return and/or
 - .2 Using audio-sensing devices.
 - .3 Use of other approved methods.
 - .2 Flash tanks.
 - .3 Thermostatic vents.
 - .3 Verify performance of condensation units, including:
 - .1 Pump capacity at design temperature.
 - .2 Controls.
 - .4 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.
 - .5 Adjust piping system as required to eliminate water hammer.
- .2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

1.4 POTABLE WATER SYSTEMS

- .1 When cleaning is completed and system filled:
 - .1 Verify performance of equipment and systems as specified elsewhere in Division 23.

- .2 Check for proper operation of water hammer arrestors. Run [one] outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
- .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

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

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.
- .2 Verification of controls, detection devices, alarm devices is specified Division 26.
- .3 Demonstrate that fire hose will reach to most remote location regardless of partitions, and obstructions.
- .4 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.6 SANITARY AND STORM DRAINAGE SYSTEMS

- .1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: refer to Section 22 42 00 - Plumbing Fixtures.

1.7 REPORTS

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx)
Requirements: Reports, supplemented as specified herein.

1.8 TRAINING

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx)
Requirements: Training of O M Personnel.

Part 2 Products**2.1 NOT USED****Part 3 Execution****3.1 NOT USED****END OF SECTION**

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

Part 2 Products**2.1 CLEANING SOLUTIONS**

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

Part 3 Execution**3.1 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 CLEANING HYDRONIC AND STEAM SYSTEMS

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

- .6 Report on Completion of Cleaning:
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Steam Systems: in addition to general requirements as specified above, perform following:
 - .1 Remove internal components of steam traps until flushing and warm-up have been completed.
 - .2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.
 - .3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.
 - .4 Water hammer: determine source and eliminate cause.

3.3 CLEANING

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

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.
 - .2 ASME B16.25, Buttwelding Ends.
 - .3 ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .4 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through 24.
 - .5 ANSI/ASME B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
 - .6 ANSI B18.2.1, Square and Hex Bolts and Screws (Inch Series).
 - .7 ANSI/ASME B18.2.2, Square and Hex Nuts (Inch Series).
- .2 American National Standards Institute (ANSI) / American Water Works Association (AWWA)
 - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .3 ASTM International Inc.
 - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
 - .1 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS-SP-71, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
 - .4 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for valves and pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.5 EXTRA MATERIALS

- .1 Extra Stock Materials:
 - .1 Provide spare parts as follows:
 - .1 Valve seats: one for every ten valves, each size. Minimum one.
 - .2 Discs: one for every ten valves, each size. Minimum one.
 - .3 Stem packing: one for every ten valves, each size. Minimum one.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every ten flanges.

Part 2 Products**2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 Steam;
 - .1 To NPS 6: Schedule 40.
 - .2 Condensate: Schedule 80.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape or lead-free dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Flanges: plain or raised face. Flange gaskets to ANSI/AWWA C111/A21.11.
- .4 Pipe thread: taper.

- .5 Bolts and nuts: carbon steel, to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.
- .6 Buttwelding ends: to ANSI/ASME B16.25.

2.3 FITTINGS

- .1 Pipe flanges: cast-iron to ASME B16.1, Class 125.
- .2 Screwed fittings: malleable iron to ASME B16.3, Class 150.
- .3 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.
- .4 Buttwelding fittings: steel to ANSI/ASME B16.9.
- .5 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

2.4 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2 1/2 and larger:
 - .1 Equipment: Flanged or welded ends.
 - .2 Elsewhere: Flanged or welded ends.
- .2 Gate valves: Application: Steam service, for isolating equipment, control valves, pipelines.
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem, wedge disc, as specified Section 23 05 23.01 - Valves-Bronze.
 - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves-Bronze.
 - .2 NPS 2 1/2 -8:
 - .1 Mechanical Rooms: Class 150, rising stem, wedge disc, cast iron, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: handwheel.
 - .2 Elsewhere: Class 150, Non-rising stem, solid wedge disc, cast iron with bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: handwheel.
- .3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass.
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: with composition disc as specified Section 23 05 23.01 - Valves - Bronze.

- .2 NPS 2 1/2 and over:
 - .1 With bronze disc, cast iron with bronze trim, to Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: handwheel.
- .4 Gate valves: Application: pumped and gravity condensate return service, steam drip point assemblies.
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, as specified Section 23 05 23.01 - Valves-Bronze.
 - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, cast iron, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: handwheel.
 - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, cast iron with bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Bypass valves around large size gate valves: as specified Section 23 05 23.03 - Valves - Cast Steel.
- .7 Lift check valves:
 - .1 NPS 2 and under: Class 125, lift, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over: as specified Section 23 05 23.02 - Valves - Cast Iron.

2.5 VALVE OPERATORS

- .1 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Mechanical Equipment rooms.

Part 3 Execution**3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PIPING

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipework and supplemented as specified below.
- .2 Connect branch lines into top of mains.
- .3 Install piping in direction of flow with slopes as follows, unless indicated:
 - .1 Steam: 1:240.
 - .2 Condensate return: 1:70.
- .4 Make provision for thermal expansion as indicated.
- .5 Drip pocket: line size.

3.3 VALVES

- .1 Install globe valves around, NPS 8 and over, gate valves.

3.4 TESTING

- .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

3.5 SYSTEM START-UP

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

3.6 PERFORMANCE VERIFICATION (PV)

- .1 General:
 - .1 Verify performance in accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems supplemented as specified herein.
- .2 Timing, only after:
 - .1 Pressure tests successfully completed.
 - .2 Flushing as specified has been completed.
 - .3 Water treatment system has been commissioned.
- .3 PV Procedures:
 - .1 Verify complete drainage of condensate from steam coils.
 - .2 Verify proper operation of system components, including, but not limited to:
 - .1 Steam traps - verify no blow-by.
 - .2 Flash tanks.
 - .3 Thermostatic vents.

- .3 Monitor operation of provisions for controlled pipe movement including expansion joints, loops, guides, anchors.
 - .1 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .4 Condensate pumping units: for commissioning procedures, refer to Section 01 91 13 - General Commissioning (Cx) Requirements.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American Society for Mechanical Engineers (ASME International)
- .2 ASTM International Inc.
 - .1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
 - .3 ASTM A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.
 - .4 ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .5 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.
 - .6 ASTM A278/A278M, Standard Specification for Gray Iron Castings for Pressure - Containing Parts for Temperatures up to 650 Degrees F (350 degrees C).
 - .7 ASTM A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - .8 ASTM A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
 - .9 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature Canadian Registration Number (CRN), and datasheets for steam traps, vacuum breakers, pressure reducing valves, air vents, safety relief valves, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MATERIALS

- .1 Cast steel: to ASTM A216/A216M.
- .2 Cast iron: to ASTM A278, Class 300.
- .3 Bronze: to ASTM B62.
- .4 Stainless steel: to ASTM A351/A351M.

2.2 INVERTED BUCKET STEAM TRAP 0-1000 KPA

- .1 Application: for non-modulating steam services on heating coils end of line drips as indicated.
- .2 Materials: body - cast iron; valve - stainless steel; bucket-stainless steel, with bimetal air vent.
- .3 Capacity: as indicated.

2.3 VACUUM BREAKERS 0.85-68 KPA

- .1 Application: on inlets to steam coils, heat exchangers as indicated.
- .2 Materials: body and cap - stainless steel; spring - stainless steel; stem and seat - stainless steel.
- .3 Capacity: as indicated.

2.4 PRESSURE REDUCING VALVE -EXTERNAL PILOT OPERATED

- .1 Location: as indicated.
- .2 Self operating, external pilot, single seat, diaphragm operated, dead end shutoff, enclosed spring chamber main and pilot valve.
- .3 Connections:
 - .1 Under NPS 2: screwed ends.
 - .2 NPS 2-1/2 and over: flanged ends.
- .4 Main valve:
 - .1 Body: cast iron to ASTM A126, Class B.
 - .2 Diaphragm: stainless steel to ASTM A167.
 - .3 Seat rings: stainless steel to ASTM A276.

- .4 Disc: stainless steel to ASTM A564/A564M.
- .5 Stem: stainless steel to ASTM A276.
- .6 Spring: carbon steel.
- .7 Bolting: carbon steel.

.5 Pilot valve:

- .1 Body: cast iron to ASTM A126, Class B.
- .2 Diaphragm: stainless steel to ASTM A167.

.6 Capacity:

- .1 780 kg/h from 860 kPa to 100 kPa.

2.5 PRESSURE REGULATOR WITH A MANUAL CONTROL

- .1 Location: as indicated.
- .2 Manual pressure regulator, with membrane, single seat for vapor operation including isolating valve.
- .3 Connections:
 - .1 Under NPS 2: screwed ends.
- .4 Main valve:
 - .1 Body: bronze comply with ASTM B854.
 - .2 Seat rings: Stainless steel comply with AISI 440.
 - .3 Spring: carbone steel.
- .5 Capacity:
 - .1 50 kg/h from 83 kPa to 830 kpa.

2.6 SAFETY AND RELIEF VALVES

- .1 Spring loaded type of bronze with high capacity and full nozzle and to ASME code.
- .2 Material: body - forged copper alloy; valve - housing cast bronze; spring – stainless steel; bronze/brass trim.
- .3 Capacity: 780 kg/h at 860 kPa setting.

2.7 DRIP PAN ELBOWS

- .1 Application: on discharge of steam safety relief valves as indicated.
- .2 Cast iron or steel with screwed or flanged inlet and threaded drain connections.

2.8 PIPE LINE STRAINERS UP TO NPS 2

- .1 Application: ahead of condensate pumps, steam traps, control valves and elsewhere as indicated.
- .2 Working pressure: 860 kPa.

- .3 Body: cast iron.
- .4 Connections: screwed.
- .5 Screen: stainless steel with 0.8 mm perforations.

2.9 PIPE LINE STRAINERS NPS 2-1/2 AND OVER

- .1 Application: ahead of condensate pumps, steam traps, control valves as indicated.
- .2 Working pressure: 860 kPa.
- .3 Body: cast iron.
- .4 Connections: flanged.
- .5 Blowdown connection: NPS 1-1/4 complete with gate valve and cap.
- .6 Screen: stainless steel with 3.2 mm perforations.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Maintain proper clearance around equipment to permit maintenance.

3.2 STRAINERS

- .1 Install as indicated.
- .2 Ensure clearance for removal of basket.
- .3 Install valved blow-down as indicated.

3.3 SAFETY RELIEF VALVE

- .1 Pipe to atmosphere independent of other vents and in accordance with applicable code.
- .2 Support discharge pipe against reaction forces and to take up thermal movement.
- .3 Drain pipe from drip pan elbow to terminate over floor drain.

3.4 STEAM TRAPS

- .1 Install unions on inlet and outlet.

3.5 PRESSURE REDUCING VALVES

- .1 Install on 3-valve bypass with strainer on inlet.
- .2 Pipe as indicated. Follow manufacturer's installation instructions.

3.6 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for units and pumps, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .1 Pump curves with point of operation.
 - .2 Required NPSH at specified maximum condensate temperature.
 - .3 Tank capacity.
 - .4 Manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories, controllers.
 - .2 Indicate control equipment, piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.
 - .3 Indicate seismic restraint system incorporated into support system.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 One set of internal parts for each type and size, orifice, or steam trap installed on this project.
 - .3 One set of internal parts for each type and size, orifice, or vacuum breaker installed on this project.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 ELECTRIC CONDENSATE UNIT, BASE MOUNTED PUMPS – P01-CON-001

- .1 Suitable for service up to 93 degrees C.
- .2 General: single unit mounted on common base piped to horizontal tank of 57 l. maximum dimension of 585 x 440 x 360 mm.
- .3 Base: fabricated steel or cast iron with drip sump and drain tapping, anchor bolt holes. Hold down bolts with sleeves seismic restraint system complete with installation template.
- .4 Pump:
 - .1 Volute: cast iron radially split, screwed suction and discharge connections, tappings for vent, drain, pressure gauge on suction and discharge.
 - .2 Impeller: cast bronze, securely keyed to shaft, replaceable wear rings.
 - .3 Shaft: alloy steel.
 - .4 Seals: mechanical.
 - .5 Bearings: in-board and out-board single race ball bearings grease lubricated.
 - .6 Coupling: flexible self-aligning.
 - .7 Motor: EEMAC Class B, squirrel cage induction, 3,500 tr/min, continuous duty, drip proof, ball bearing, maximum temperature rise 50 degrees C.
- .5 Tank: welded steel construction to 125 psi rating return connections both ends, pump suction, overflow, vent and drain connections. Opening for float control internal. Steel support legs. Valved gauge glass with guard.
- .6 Piping valves and fittings: to Section 23 22 13 - Steam and Condensate Heating Piping.
- .7 Controls:
 - .1 Float switches: quick double break type with silver contacts. Seamless copper float with bronze rod and packed stuffing box.
 - .2 Wiring between pumps and controls by unit manufacturer.
- .8 Capacity: as indicated:
 - .1 Tank: 57 L capacity.
 - .2 Flow: 0.75 L/s.
 - .3 Pressure at pump discharge: 140 kPa.
 - .4 Motor: 1/3 HP.
 - .5 Electrical connection: 120 V/1 ph/60 Hz.

2.2 PACKAGE CONDENSATE UNIT, TANK MOUNTED PUMPS – P02-CON-001

- .1 Suitable for service up to 93 degrees C.
- .2 General: tank, pump and all accessories mounted on a base for hanging.

- .3 Pump:
 - .1 Volute: cast iron, radially split, screwed discharge connection.
 - .2 Seals: mechanical.
- .4 Tank: welded steel construction to 200 psi rating; steel pump openings, internal opening for float control, return connections on each end, vent and drain and overflow connections, thermometer, valved gauge glass with guard.
- .5 Controls:
 - .1 Float switches: quick double break type with silver contacts. Seamless copper float with bronze rod and packed stuffing box.
 - .2 Wiring between pumps and controls.
- .6 Capacity:
 - .1 Tank: 3.8 L capacity.
 - .2 Flow: 0.58 L/s.
 - .3 Pressure at pump discharge: 34 kPa.
 - .4 Fill head: 150 mm.
 - .5 Dimensions of the package: 900 x 750 x 750 mm.
 - .6 Full weight: 250 kg.

Part 3 Execution**3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Place level, shim unit and grout.
- .2 Pipe up to system as indicated.
- .3 Run tank vent separately to exterior of building as indicated.
- .4 Run drain line and overflow to terminate over floor drain.
- .5 Check rotation prior to start-up.
- .6 Check bearings for oil level and lubrication.

3.3 SYSTEM START-UP AND PERFORMANCE VERIFICATION (PV)

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements, supplemented as specified herein.

- .2 Start-up:
 - .1 Check strainers and clean as often as necessary until system is clean.
 - .2 Tighten as necessary glands of valves, pumps.
 - .3 Check lubrication and add as necessary.
 - .4 Determine source of loss and rectify deficiencies.
- .3 Performance Verification (PV):
 - .1 Test unit for capacity, NPSH at design temperatures.
 - .2 Discharge condensate to sewer until system is clean.
- .4 Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports supplemented as specified herein.
 - .2 Include:
 - .1 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: report forms and schematics.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 ASME
 - .1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
 - .3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International
 - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .2 ASTM B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group
 - .1 CSA B52, B52 Package, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
 - .1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building construction subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for refrigerant piping for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect refrigerant piping, fittings and equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280, type ACR.
 - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

- .3 Flanged:
 - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
 - .2 Gaskets: suitable for service.
 - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .4 Flared:
 - .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for refrigerant piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.

3.4 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.5 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m³/s at minimum load. Connect upstream of traps on large riser.

3.6 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.
- .3 Test procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 hours.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 hours.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Departmental Representative.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to Departmental Representative.
- .9 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .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, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
 - .1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-36, Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual.
 - .3 IAQ Guideline for Occupied Buildings Under Construction.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.

- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .4 Test and Evaluation Reports:
 - .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
 - .2 Construction IAQ Management Plan:
 - .1 Submit Indoor Air Quality (IAQ) Plan for construction phases of building.
 - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings Under Construction.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C

- .2 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with gaskets. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Sustainability Characteristics:
 - .1 Adhesives and sealants: in accordance with Section 07 92 00 - Joint Sealants.

- .2 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

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

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

- .2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
- .3 Joints: to ASHRAE and SMACNA.

2.8 KITCHEN EXHAUST SYSTEMS

- .1 Construct in accordance with NFPA 96.
- .2 Material: black steel sheet.
- .3 Thickness: 16 gauge.
- .4 Fabrication: as SMACNA.
- .5 Reinforcement: as SMACNA.
- .6 Drainage: slope to the hood.
- .7 Grease filters: to Section 23 38 13 - Commercial Kitchen Hoods.

2.9 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
 - .2 Hanger configuration: to ASHRAE and SMACNA.
 - .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA.
 - .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.

2.10 Duct silencers

- .1 Passive rectangular silencers
 - .1 Outer casing of 22 gauge (minimum) galvanized steel, with resistant and airtight mastic sealed seams for pressures exceeding 1,250 Pa (5").
 - .2 Internal baffles of 22 gauge perforated galvanized steel, packed with acoustic media consisting of long fiberglass wool compressed 10%. Weld baffles to internal panel at every 75 mm (3") maximum.
 - .3 Where two or more modules are required, supply galvanized steel U channels to provide airtight joints during field erection. Protect the acoustic media from erosion with a fiberglass cloth when air velocities exceed 22.5 m/s (4,500 ft./min).
 - .4 Capacity: as indicated.

2.11 FIREPROOFING WRAP

- .1 Flexible, light, non wooden insulating jacket, 96 kg/m³ (6 lbs/ft³) and 38 mm (1.5 in.) thick, asbestos free, high temperature resistant, made of biosoluble calcium-magnesium-silicate (CMS) fiber, encapsulated in a metal sheet reinforced by a canvas.
- .2 ULC classified, 1,000 °C (1,832 °F) service temperature, thermal resistance at 25 °C (77 °F): RSI: 1.12 (R = 6.38), flame spread index: 0, smoke spread index: 0.
- .3 FRD system: "Fire Resistant Duct".
- .4 For installation on commercial kitchen hood exhaust duct, comply with NFPA96.
- .5 Accessories
 - .1 Carbon steel banding, for one (1) hour fire resistance.
 - .2 Stainless steel banding for two (2) hours fire resistance.
 - .3 Welding pins and 40 mm (1.5") steel clips.
 - .4 Galvanized steel rods, 6 mm (¼") diameter, wing nuts and steel tubing for access doors.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with ASHRAE and SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.3 HANGERS

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

3.4 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Dishwasher exhaust.
 - .2 Fresh air intake.
 - .3 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Weld joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards fume hoods served.
 - .1 Slope header ducts down toward risers.
- .4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve and discharging to open funnel drain.

3.5 KITCHEN EXHAUST SYSTEMS

- .1 Install to NFPA 96.

3.6 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.7 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

3.8 Fireproofing wrap

- .1 Install in accordance to manufacturer's recommendations.
- .2 For one-hour fire protection, install one layer, 38 mm (1½") thick. Where two (2) hours fire protection is required, install two (2) layers to obtain 75 mm (3"). Employ a 75 mm (3") minimum overlap.
- .3 For duct span greater than 600 mm (24"), install pins and clips on the bottom of horizontal runs and on vertical runs.
- .4 Install steel banding on exterior layer.
- .5 For external fire threat conditions, wrap independently horizontal and vertical supports and hangers.
- .6 Wrap each duct independently.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame thick with fabric clenched by means of double locked seams.

- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene or foam rubber.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks.
 - .2 301 to 450 mm: four sash locks.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.

2.4 TURNING VANES

- .1 Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

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

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
 - .1 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

- .1 Ducted inlets to roof and wall exhausters.
- .2 Inlets and outlets of other fan systems.
- .3 Main and sub-main ducts.
- .4 And as indicated.

.2 For temperature readings:

- .1 At outside air intakes.
- .2 In mixed air applications in locations as approved by Departmental Representative.
- .3 At inlet and outlet of coils.
- .4 Downstream of junctions of two converging air streams of different temperatures.
- .5 And as indicated.

.4 Turning Vanes:

- .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Single thickness construction.

- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon or bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: pin in bronze bushings self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install where indicated.

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

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

- .1 Opposed blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

- .5 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 800 Pa differential across damper.
- .6 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.2 RELIEF DAMPERS

- .1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .4 Underwriters' Laboratories (UL)
 - .1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S110, Standard Methods of Tests for Air Ducts.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect flexible ducts from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC - INSULATED

- .1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and reinforced mylar/neoprene laminate jacket, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for flexible ducts installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110, UL 181, NFPA 90A and NFPA 90B.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99, Standards Handbook.
 - .2 ANSI/AMCA Standard 210/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - .5 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Provide:
 - .1 Fan performance curves showing point of operation, bhp, kW and efficiency.
 - .2 Sound rating data at point of operation.
 - .3 Indicate:
 - .1 Motors, sheaves, bearings and shaft details.
 - .2 The minimum efficiency with a speed variation device.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Provide:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

- .1 Bearings and seals.
- .2 Addresses of suppliers.
- .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, total and static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 Sizes as indicated.

- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment, inlet or outlet dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.3**BELT DRIVE CENTRIFUGAL ROOF EXHAUSTERS**

- .1 Housing is constructed of 16 gauge spun aluminium, reinforced for maximum strength; base assembly to be 3003 aluminium alloy with welded corners for maximum leak protection; motor and fan assembly are on vibration isolating mounts; centrifugal wheel is non-overloading backward inclined design, statically and dynamically balanced.
- .2 Self aligning, heavy duty ball bearings, grease lubricated and selected for minimum life (L5) of 200,000 hours at maximum operating speed; rust protected shafts sized so that the first critical speed is at least 30% over the maximum operating speed. Pulleys to be adjustable and sized for a minimum of 150% of the installed motor horsepower; supply fans with pulleys installed and adjusted to specified RPM.
- .3 Provide a roof curb of 450 mm of height.
- .4 Provide fans with a continuous curb gasket and stainless steel securing bolts and screws.
- .5 Accessories and options
 - .1 12 mm (½") aluminium bird screen; hinge curb plate for access to internal parts for maintenance; integral prewired disconnect switch within fan housing; automatic gasketed back draft dampers;
- .6 Capacity: as indicated.
- .7 Acceptable products:
 - .1 Acme CentriMaster PNN;
 - .2 Cook ACEB;
 - .3 Greenheck GB;
 - .4 JennFann NBCR Series;
 - .5 Penn Domex.

2.4 COMMERCIAL KITCHEN HOOD EXHAUSTERS

- .1 Units to be U.L. approved for U.L. 762 "Restaurant Exhaust Appliances", tested for 205 °C (400 °F) continuous discharge air temperature, and to comply with NFPA 96 "Vapor Removal for Cooking Equipment".
- .2 Housing is constructed of heavy gauge spun aluminium, reinforced for maximum strength; base assembly to be 3003 aluminium alloy with welded corners for maximum weather resistance. Grease shall be collected and drained at a single point in the base. The drain includes a swivel downspout for discharge into a grease collection box.
- .3 Centrifugal wheel, non-overloading backward inclined design, statically and dynamically balanced; self aligning, heavy duty ball bearings, grease lubricated and selected for minimum life (L50) of 200,000 hours at maximum operating speed; rust protected shafts sized so that the first critical speed is at least 30% over the maximum operating speed.
- .4 Motors are heavy-duty ball bearing totally enclosed design. Motor, drives and shafts to be mounted on vibration isolators. Pulleys to be adjustable and sized for a minimum of 150% of the installed motor horsepower; supply fans with pulleys installed and adjusted to specified RPM.
- .5 Accessories and options
 - .1 Integral factory wired weatherproof junction box and disconnect switch; matching ventilated roof curb conforming to the provisions of NFPA 96; hinging arrangement on the base of the unit with hold-open retainer chain for easy maintenance and inspection.
- .6 Capacity: as indicated.
- .7 Acceptable products:
 - .1 Acme CentriMaster PUB;
 - .2 Cook VCR/VCR-HP;
 - .3 Greenheck CUBE;
 - .4 JennFan NBRTD;
 - .5 Penn Domex.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated. Every grilles and diffusers must be in steel.

- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames and as specified.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as directed by Departmental Representative.

2.3 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.4 SUPPLY GRILLES AND REGISTERS

- .1 See Mechanical Table.

2.5 DIFFUSERS

- .1 See Mechanical Table.

2.6 SECURITY GRILL IN THE VENTILATION DUCTS

- .1 Steel bars of at least 12 mm of diameter and spaced of 137 mm.
- .2 The maximum length of the cross bars must not exceed 610 mm and all the bars must be welded together when they cross.
- .3 The bars must be welded to a frame attached to flat steel to concrete or masonry. Accepted method: bolts placed at least 50 mm in metal pads. The spacing of the bolts doesn't exceed 400 mm. At least 4 bolts per grille.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers instructions.

- .2 Install with flat head stainless steel screws vandal proof in countersunk holes where fastenings are visible.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 ASTM International
 - .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .4 Society of Automotive Engineers (SAE)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 FACTORY MADE FRESH AIR INTAKES (ROOF MOUNTED LOUVER)

- .1 Custom made, aluminium structure, weatherproof louvers with extruded blades, ground and welded at the ends; integral 12 mm (½") mesh of 2.7 mm (7/64") diameter aluminium wired birdscreen; internal structure made of extruded steel.
- .2 Maximum throat velocity: 1.5 m/s (300 FPM).
- .3 Maximum loss through unit: 15 Pa (0.06 H₂O) static pressure.
- .4 Shape: as indicated
 - .1 Louvers must comply with the article "Louvers" of this Section.
- .5 Dimensions as shown on drawings.

2.3 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 3 mm thick.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel. Colour: to Departmental Representative's approval.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for louvres, intakes and vents installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
 - .1 ANSI/AHRI 430, Performance Rating of Central Station Air-Handling Units.
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
 - .1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - .2 ANSI/ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .3 Green Seal (GS)
 - .1 GS-11, Standard for Paints and Coatings.
 - .2 GS-36, Standard for Adhesives for Commercial Use.
- .4 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1113, Architectural Coatings.
 - .2 SCAQMD Rule 1168, Adhesives and Sealants.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for insulation, filters, adhesives, and paints and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.
 - .2 Indicate on drawings: fan fan curves showing point of operation motor drive bearings filters mixing box dampers VAV coil; include performance data.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.

- .3 Include following: fan, bearings, motor, damper, VAV control.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 1 spare set of filters.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air handling equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: to ANSI/AHRI 430 with AHRI seal.
- .3 Horizontal type, as indicated, having air tight modular components, consisting of casing, fan section with motor and drive, filter section and heating coil.
- .4 The package dimensions must be 3 800 mm of length, 2100 mm of large and 1075 mm of height.
- .5 Every access doors must be on the left side when the supply is in front.

2.2 CASINGS

- .1 Galvanized steel reinforced and braced for rigidity.
 - .1 Inspection doors: provide access for maintenance of internal parts.
 - .2 Paint steel parts, where not galvanized, with corrosion resistant paint to MPI #18.
 - .1 Paint: maximum VOC limit 250 g/L to GS-11.
- .2 Line casing with solid steel liner.

2.3 ACOUSTIC LINER

- .1 Ensure that expanded polystyrene and polyurethane insulation materials were not produced with ozone depleting substances.
- .2 Insulate internal surface of panels with 50 mm neoprene coated rigid duct liner of 72 kg/m³ density.
 - .1 Apply with 100% coverage of adhesive with clip pins.
 - .1 Adhesives: maximum VOC limit 80g/L to GS-36.
 - .2 Cover with 0.8 mm thick perforated galvanized sheet metal.
 - .3 Cover leading and trailing edges with sheet metal nosing and at edges around access doors and panels complete with 15 mm overlap.

2.4 FANS

- .1 AMCA-rated for sound and performance plenum fans, selected to operate in stable part of performance curve at times and heavy duty 200,000 hours service self aligning split pillow block bearings.
 - .1 Provide internally mounted premium motor as indicated complete with adjustable V-belt drive and guard.
 - .2 Motor: to ANSI/ASHRAE/IES 90.1 of 15 hp, W, r/min.
 - .3 Maximum sound power levels, of 85 dBa at the discharge of the unit.
 - .4 Electrical connection: 575/3/60.
- .2 Internally mounted motor and fan.
- .3 Capacity: 4250 L/s with a static pressure of 250 Pa.

2.5 VIBRATION ISOLATION

- .1 Flexible connections at inlet and outlet of fan: to Section 23 33 00 - Air Duct Accessories.
- .2 Vibration isolators complete with seismic restraints: in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.6 FILTER BOX

- .1 Material to match casing. For flat V type filter arrangement:
 - .1 Provide access to filter through hinged door with suitable hardware.

- .2 Provide blank-off plates and gaskets to prevent air bypass.
- .3 Filters: of 50 mm.
 - .1 Minimum Efficiency Reporting Value (MERV) value 8 filtration media to ANSI/ASHRAE 52.2, to be used on return air section of air handling unit.

2.7 COILS

- .1 Capacity: 265 kW with a 4250 L/s flow and 954 lb/h of vapor at 103 kPa.
- .2 Ratings: AHRI certified.
- .3 Construction:
 - .1 Casings: 1.5 mm thick galvanized sheet steel.
 - .1 Supports of galvanized steel channel.
 - .2 Blank-off plates. Insulated sandwich construction.
 - .2 Non-freeze steam coils: tube-in-tube type with internal perforated steam distributing tubes. Slope tubes to drain condensate.
 - .1 Tubes: copper.
 - .2 Fins: aluminum.
 - .3 Headers: cast iron.
 - .4 Pressure tests: 1.7 MPa.

2.8 OPTIONS OF THE AIR HANDLING UNIT

- .1 Include a starter and a disconnect switch pre-wired and pre-installed.
- .2 Install the package on 75 mm steel beam with hook for suspension.
- .3 Include the actuator for the non-freeze system.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air handling equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.

- .3 Ensure adequate clearance for servicing and maintenance.

3.3 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

3.4 DRIP PANS

- .1 Install deep seal P-traps and trap seal primer on drip lines.
 - .1 Depth of water seal to be 1.5 times static pressure at this point.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 210/240, Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
 - .1 ANSI/ASHRAE Standard 15, Safety Standard for Refrigeration Systems.
- .3 Air-Conditioning and Refrigeration Institute (ARI)
 - .1 ARI 320, Standard for Water-Source Heat Pumps.
- .4 CSA International
 - .1 CAN/CSA-C656, Performance Standard for Split-System and Single Package Central Air Conditioners and Heat Pumps.
- .5 Environment Canada, (EC) / Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
 - .2 Environment Canada, Ozone-Depleting Substances Alternatives and Suppliers List.
- .6 National Fire Protection Association (NFPA)
 - .1 NFPA 90A, Standard for Installation of Air Conditioning and Ventilating Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for heat pumps and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for heat pumps for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect heat pumps from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 WARRANTY

- .1 5 years warranty on the pieces and 7 years warranty for the compressors.

Part 2 Products**2.1 DESCRIPTION**

- .1 Heat pumps: to EPS 1/RA/2, CSA approved and with ARI or CSA certification seal.

2.2 REFRIGERANTS

- .1 Type of Refrigerant: R410A.

2.3 SINGLE PACKAGE ROOF MOUNTED AIR-SOURCE HEAT PUMP (CC1-REF-002, CC2-REF-002, EVI-REF-001 and EV2-REF-001)

- .1 General:
 - .1 One-piece, air-source roof mounted heat pump for year-round operation.
 - .2 Factory assembled and tested, complete with refrigerant charge, ready to operate.
 - .3 ULC Listed and labelled.
 - .4 One piece curb of 450 mm of height.
 - .5 Design for use with R410A.
- .2 Performance: as indicated.
 - .1 Electrical: 208 V, 1 ph, 60 Hz.
 - .2 Cooling:
 - .1 Total: 2.6 kW minimum.
 - .2 Outdoor coil: dry bulb entering air of 35 degrees C and wet bulb entering air of 23 degrees C.
 - .3 EER: 13.8 minimum.

- .3 Heating:
 - .1 Capacity: 3.5 kW minimum.
 - .2 Outdoor coil: dry bulb entering air of 8.3 degrees C and wet bulb entering air of 6 degrees C.
 - .3 EER: 13.4 minimum
- .4 Liquid refrigerant heat:
 - .1 Discharge connection: 6 mm.
 - .2 Suction connection: 10 mm.
- .5 Supply fan: 120 L/s minimum and at least 3 speeds.
- .6 Ratings: in accordance with CAN/CSA-C656.
- .3 Compressor:
 - .1 Welded, hermetic with crankcase heaters, vibration isolators.
 - .2 Design and test to operate with outside air at on heating cycle without shutting off and at 1.6 degrees C on cooling cycle with specified air flow.
 - .3 Separate and independent refrigeration and control system for each compressor.
- .4 Coils: aluminum fins, mechanically bonded to seamless copper tubes with all joints brazed.
- .5 Indoor supply air fan: forward curved, centrifugal, statically and dynamically balanced.
- .6 Outdoor air fan: vertical discharge propeller type, statically and dynamically balanced, direct drive with permanently lubricated motor bearings.
- .7 Filter:
 - .1 Deodorant and antibacterial ions filters.
- .8 Refrigeration piping:
 - .1 Between compressor, outdoor coil and indoor coil, complete with refrigerant metering devices and valves.
 - .2 Refer to Section 23 23 00 - Refrigerant Piping.
- .9 Roof curb: by unit manufacturer, minimum 450 mm high, designed to Canadian Roofing Contractors Association (CRCA) and seismic requirements, thermally insulated panel under compressor section, hold-down bolts.
- .10 Controls:
 - .1 Protection: manual reset high and low pressure stats, loss-of-charge, indoor coil freeze stat, current temperature overload devices.
 - .2 Night mode, dry mode, economy mode, auto restart, auto reverse and internal control between the compressor and the evaporator.
 - .3 Include a wall controller and the wiring.

**2.4 SINGLE PACKAGE ROOF MOUNTED AIR-SOURCE HEAT PUMP
(CC3-REF-002 and EV3-REF-001)****.1 General:**

- .1 One-piece, air-source roof mounted heat pump for year-round operation.
- .2 Factory assembled and tested, complete with refrigerant charge, ready to operate.
- .3 ULC Listed and labelled.
- .4 One piece curb of 450 mm of height.
- .5 Design for use with R410A.

.2 Performance: as indicated.

- .1 Electrical: 208 V, 1 ph, 60 Hz.
- .2 Cooling:
 - .1 Total: 12.3 kW minimum.
 - .2 Outdoor coil: dry bulb entering air of 35 degrees C and wet bulb entering air of 23 degrees C.
 - .3 EER: 10.3 minimum.
- .3 Heating:
 - .1 Capacity: 13.75 kW minimum.
 - .2 HSPF: 8.6 minimum
- .4 Liquid refrigerant heat:
 - .1 Discharge connection: 10 mm.
 - .2 Suction connection: 16 mm.
- .5 Supply fan: 430 L/s minimum and at least 4 speeds.
- .6 Ratings: in accordance with CAN/CSA-C656.

.3 Compressor:

- .1 Welded, hermetic with crankcase heaters, vibration isolators.
- .2 Design and test to operate with outside air at on heating cycle without shutting off and at 1.6 degrees C on cooling cycle with specified air flow.
- .3 Separate and independent refrigeration and control system for each compressor.

.4 Coils: aluminum fins, mechanically bonded to seamless copper tubes with all joints brazed.**.5 Indoor supply air fan: forward curved, centrifugal, statically and dynamically balanced.****.6 Outdoor air fan: vertical discharge propeller type, statically and dynamically balanced, direct drive with permanently lubricated motor bearings.****.7 Filter:**

- .1 Deodorant and antibacterial ions filters.

- .8 Refrigeration piping:
 - .1 Between compressor, outdoor coil and indoor coil, complete with refrigerant metering devices and valves.
 - .2 Refer to Section 23 23 00 - Refrigerant Piping.
- .9 Roof curb: by unit manufacturer, minimum 450 mm high, designed to Canadian Roofing Contractors Association (CRCA) and seismic requirements, thermally insulated panel under compressor section, hold-down bolts.
- .10 Controls:
 - .1 Protection: manual reset high and low pressure stats, loss-of-charge, indoor coil freeze stat, current temperature overload devices.
 - .2 Night mode, dry mode, economy mode, auto restart, auto reverse and internal control between the compressor and the evaporator.
 - .3 Include a wall controller and the wiring.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for heat pumps installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install where indicated and in accordance with manufacturer's instructions.
- .2 Install the compressor on the roof curb.
- .3 Install outdoor units on roof with vibration isolation providing 95% isolation efficiency.
- .4 Secure with hold-down bolts in accordance with manufacturer's recommendations.
- .5 Make duct connections through flexible connections.
- .6 Level unit with fans running. Align duct work. flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.
- .7 Make piping connections.
- .8 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.3 START-UP AND COMMISSIONING

- .1 Have manufacturer certify installation.
- .2 Have manufacturer present tests and start up units and certify performance.
- .3 Submit written start-up and commissioning reports to Departmental Representative.

3.4 CLOSEOUT ACTIVITIES

- .1 Manufacturer to deliver verbal and written instructions to operating personnel.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 PROTECTION

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

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes.
 - .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
 - .1 Start-up testing and verification of systems.
 - .2 Check out demonstration or proper operation of components.
 - .3 On-site operational tests.

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

- .1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: submit report to Departmental Representative.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor
 - .3 Report format to be approved by Departmental Representative before commissioning is started.
 - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O M Manuals, and training of O M personnel for review of Departmental Representative before interim acceptance.

1.6 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative and PWGSC Commissioning Manager.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

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

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

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

Part 2 Products**2.1 EQUIPMENT**

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

Part 3 Execution**3.1 PROCEDURES**

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

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of field tests of equipment just prior to installation.
 - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
 - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source and to BECC.
 - .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
 - .8 Transmitters above 0.5 % error will be rejected.
 - .9 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D convertor.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.
 - .9 Verify each CDL including energy optimization programs.
 - .10 Debug software.

- .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
- .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and PWGSC Commissioning Manager and provide:
 - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.
 - .5 O M personnel to assist in commissioning procedures as part of training.
 - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
 - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
 - .8 Operate systems as long as necessary to commission entire project.
 - .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 30 consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

- .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
- .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
- .6 Correct defects when they occur and before resuming tests.
- .5 Commissioning Manager and Departmental Representative to verify reported results.

3.3 ADJUSTING

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

3.4 DEMONSTRATION

- .1 Demonstrate to Commissioning Manager and Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

1.2 DEFINITIONS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

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

1.5 INSTRUCTIONS

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

1.6 TIME FOR TRAINING

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

1.7 TRAINING MATERIALS

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

1.8 TRAINING PROGRAM

- .1 To be in 2 phases over 6 month period.
- .2 Phase 1: 1 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative and PWGSC Commissioning Manager.
 - .1 Train O M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30 day test period.
 - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 2 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
 - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
 - .2 Equipment maintenance training: provide personnel with 1 days training within 2 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
 - .3 Programmers: provide personnel with 1 day training within 2 day period.

1.9 ADDITIONAL TRAINING

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

- .1 Departmental Representative to monitor training program and may modify schedule and content.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
 - .1 CEA-709.1, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 ACRONYMS AND ABBREVIATIONS**.1 Acronyms used in EMCS:**

- .1 AEL - Average Effectiveness Level.
- .2 AI - Analog Input.
- .3 AIT - Agreement on International Trade.
- .4 AO - Analog Output.
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Center.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.

- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.4 DEFINITIONS

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

- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.

- .1 Printouts: to ANSI/IEEE 260.1.

- .2 Refer also to Section 25 05 54- EMCS: Identification.

1.5 SYSTEM DESCRIPTION

- .1 Refer to control schematics for system architecture.

- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:

- .1 Building Controllers.

- .2 Control devices as listed in I/O point summary tables.

- .3 OWS(s).

- .4 Data communications equipment necessary to effect EMCS data transmission system.

- .5 Field control devices.

- .6 Software/Hardware complete with full documentation.

- .7 Complete operating and maintenance manuals.

- .8 Training of personnel.

- .9 Acceptance tests, technical support during commissioning, full documentation.

- .10 Wiring interface co-ordination of equipment supplied by others.

- .11 Miscellaneous work as specified in these sections and as indicated.

- .3 Design Requirements:

- .1 Design and provide conduit and wiring linking elements of system.

- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.

- .3 Location of controllers as reviewed by Departmental Representative prior to installation.

- .4 Provide utility power to EMCS as indicated.

- .5 Metric references: in accordance with CAN/CSA Z234.1.

- .4 Language Operating Requirements:

- .1 Provide English or French operator selectable access codes.

- .2 Use non-linguistic symbols for displays on graphic terminals. Other information to be in English and French.

- .3 Operating system executive: provide primary hardware-to-software interface with associated documentation to be in English and French.

- .4 System manager software: include in English and French system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
- .5 Include, in English and French:
 - .1 Input and output commands and messages from operator-initiated functions, field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
 - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
 - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review:
 - .1 Systems manufacturers within 10 days after award of contract.
 - .2 List existing field control devices to be re-used included in [bid] [tender], along with unit price.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
 - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

- .6 Permits and fees: in accordance with general conditions of contract.
- .7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.
- .8 Existing devices intended for re-use: submit test report.

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

1.9 EXISTING- CONTROL COMPONENTS

- .1 Do not utilize existing control. Connect to existing only.
- .2 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.
 - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .3 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .4 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
 - .1 Be responsible for items repaired or replaced by Departmental Representative.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of applicable portions of EMCS as approved by Departmental Representative.
- .5 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

Part 2 Products

2.1 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: as existing and to ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of bid documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.2 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

2.3 CONNECTION TO EXISTING SYSTEM

- .1 Existing building automation system is from Regulvar. Ensure compatibility of new component with the existing system.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

END OF SECTION

Part 1 General**1.1 SUMMARY****.1 Section Includes.**

- .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 5 working days after contract award, for review by Departmental Representative.
- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

- .5 Soft copy to be in Autocad - latest version Microsoft Word latest version formats, structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller, signal levels, pressures where new EMCS ties into existing control equipment.
 - .3 Spare point capacity of each controller by number and type.
 - .4 Controller locations.
 - .5 Auxiliary control cabinet locations.
 - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
 - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
 - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
 - .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
 - .10 Compressor schematic and sizing data.

1.6 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
 - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
 - .2 Wiring diagrams.
 - .3 Piping diagrams and hook-ups.
 - .4 Interface wiring diagrams showing termination connections and signal levels.

- .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 Complete Point Name Lists.
 - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .6 Software and programming details associated with each point.
 - .7 Manufacturer's recommended installation instructions and procedures.
 - .8 Input and output signal levels or pressures where new system ties into existing control equipment.
- .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .7 Graphic system schematic displays of air systems with point identifiers and textual description of system, as specified.
- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7**QUALITY ASSURANCE**

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
 - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
 - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
 - .3 Review interface requirements of materials supplied by others.
 - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.

- .3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for final control diagrams and operation and maintenance (O M) manual, for building Energy Monitoring and Control System (EMCS) Work.

1.2 DEFINITIONS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.
- .2 Submit Operation and Maintenance Manual to Departmental Representative in English and French.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
 - .1 Changes to contract documents as well as addenda and contract extras.
 - .2 Changes to interface wiring.
 - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
 - .4 Locations of obscure devices to be indicated on drawings.
 - .5 Listing of alarm messages.
 - .6 Panel/circuit breaker number for sources of normal/emergency power.

- .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
- .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.5 O M MANUALS

- .1 Custom design O M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented for implementation in automatic mode.
- .5 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

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

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.
- .2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

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

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by plastic tie.
- .2 Sizes: 50 x 100 mm minimum.

- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

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

2.5 WIRING

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

2.6 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

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

3.2 EXISTING PANELS

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

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
 - .2 ANSI C2, National Electrical Safety Code.
 - .3 ANSI/NFPA 70, National Electrical Code.
- .2 CSA Group
 - .1 CSA C22.1,
 - .2 CAN/CSA-C22.3 No. 7, Underground Systems.
 - .3 CSA C22.2 No. 45.1, Electrical Rigid Metal Conduit.
 - .4 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .5 CSA C22.2 No. 83, Electrical Metallic Tubing.
 - .6 CAN/CSA-C22.3 No. 1, Overhead Systems.

1.2 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 Provide power wiring power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
 - .2 Hard wiring between field control devices and EMCS field panels.
 - .3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.
 - .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .5 Refer to wiring diagrams. Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by engineer before commencing work.
- .2 Mechanical:
 - .1 Pipe Taps Required For EMCS equipment will be supplied and installed by Division 23 and EMCS Contractor.
 - .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by EMCS Contractor and Division 23.
- .3 Structural:
 - .1 Special steelwork as required for installation of work.

1.3 PERSONNEL QUALIFICATIONS

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

1.4 EXISTING CONDITIONS

- .1 Cutting and Patching: refer to Section 01 73 00 - Execution supplemented as specified herein.
- .2 Repair all surfaces damaged during execution of work.
- .3 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

Part 2 Products

2.1 SPECIAL SUPPORTS

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

2.2 WIRING

- .1 As per requirements of Division 26.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .3 Sizes:
 - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
 - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
 - .3 Field wiring to digital device: #18 AWG.
 - .4 Analog input and output: shielded #18 minimum solid copper. Wiring must be continuous without joints.
 - .5 More than 4 conductors: #22 minimum solid copper.
- .4 Terminations:
 - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.3 CONDUIT

- .1 As per requirements of Division 26.

2.4 WIRING DEVICES, COVER PLATES

- .1 Conform to CSA.

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

2.5 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

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

Part 3 Execution

3.1 INSTALLATION

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

3.2 SUPPORTS

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

3.3 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Division 26, this specification.
 - .2 CSA 22.1 Canadian Electrical Code.
 - .3 ANSI/NFPA 70.
 - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.

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

3.4 WIRING DEVICES, COVER PLATES

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

3.5 GROUNDING

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

3.6 TESTS

- .1 General:
 - .1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.
 - .2 Give 14 days written notice of intention to test.
 - .3 Conduct in presence of Departmental Representative and authority having jurisdiction.
 - .4 Conceal work only after tests satisfactorily completed.

- .5 Report results of tests to Departmental Representative in writing.
- .6 Preliminary tests:
 - .1 Conduct as directed to verify compliance with specified requirements.
 - .2 Make needed changes, adjustments, replacements.
 - .3 Insulation resistance tests:
 - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
 - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and authority having jurisdiction.

3.7 IDENTIFICATION

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

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes.
 - .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).
- .2 References.
 - .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
 - .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204, Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3 Submit detailed inspection reports to Departmental Representative.
- .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Maintain records and logs of each maintenance task on site.

- .2 Organize cumulative records for each major component and for entire EMCS chronologically.
- .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

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

- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

1.5 SERVICE CONTRACTS

- .1 Provide in-depth technical expertise and assistance to Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.
- .2 Service Contracts to include:
 - .1 Annual verification of field points for operation and calibration.
 - .2 Complete inventory of installed system.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
 - .2 Check and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
 - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.

- .4 Review system performance with Departmental Representative to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.
 - .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 General**1.1 SUMMARY****.1 Section Includes:**

- .1 System requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).

1.2 REFERENCES**.1 Canadian Standards Association (CSA International).**

- .1 CSA T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
- .2 CSA T530, Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).

.2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.

- .1 IEEE Std 802.3TM-, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

.3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)

- .1 TIA/EIA-568, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
- .2 TIA/EIA-569-A, Commercial Building Standard for Telecommunications Pathways and Spaces.

.4 Treasury Board Information Technology Standard (TBITS).

- .1 TBITS 6.9, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

- .1 Existing data communication network to link Master Control Units (MCU) to the existing system, in accordance with CSA T529, TIA/EIA-568, CSA T530, TIA/EIA-569-A and TBITS 6.9.

- .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.

- .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Connect to existing system data communication network to include, but not limited to:
 - .1 EMCS-LAN.
 - .2 Network components necessary to connect and use the complete network.

1.5 DESIGN REQUIREMENTS

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 Materials and installation for building automation controllers including:
 - .1 Master Control Unit (MCU).
 - .2 Local Control Unit (LCU).
 - .3 Equipment Control Unit (ECU).
 - .4 Terminal Control Unit (TCU).

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
 - .1 C22.2 No.205, Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE C37.90.1, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
 - .1 MD250005 – Energy monitoring and control systems (EMCS) design guidelines.

1.3 DEFINITIONS

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

1.4 DESCRIPTION

- .1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.
 - .1 Provide sufficient controllers to meet intents and requirements of this section.
 - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.

- .2 Controllers: stand-alone intelligent Control Units.
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
 - .3 Capable of interfacing with operator interface device.
 - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
 - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
- .3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
 - .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
 - .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.5 DESIGN REQUIREMENTS

- .1 To include:
 - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
 - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
 - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
 - .4 Control of systems as described in sequence of operations.
 - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.
- .3 Field Termination and Interface Devices:
 - .1 To: CSA C22.2 No.205.
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
 - .2 Power supplies for operation of logics devices and associated field equipment.

- .3 Lockable wall cabinet.
- .4 Required communications equipment and wiring (if remote units).
- .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
- .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
- .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
 - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 – 20 mA;
 - .2 0 – 10 V DC;
 - .3 100/1000 ohm RTD input;
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
 - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
 - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4 – 20 mA.
 - .2 0 – 10 V DC.
 - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
 - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1 surge withstand capability.
 - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
 - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
 - .1 Provide for conduit entrance from top, bottom or sides of panel.
 - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
 - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

Part 2 Products

2.1 MASTER CONTROL UNIT (MCU)

- .1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
 - .1 MCU must support Proprietary Protocol and/or BACnet.
- .3 MCU local I/O capacity as follows:
 - .1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
 - .2 LCUs may be added to support system functions.
- .4 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
 - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative.
 - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

- .3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English and French.
- .4 Functions to include, but not be limited to, following:
 - .1 Start and stop points.
 - .2 Modify setpoints.
 - .3 Modify PID loop parameters.
 - .4 Override PID control.
 - .5 Change time/date.
 - .6 Add/modify/start/stop weekly scheduling.
 - .7 Add/modify setpoint weekly scheduling.
 - .8 Enter temporary override schedules.
 - .9 Define holiday schedules.
 - .10 View analog limits.
 - .11 Enter/modify analog warning limits.
 - .12 Enter/modify analog alarm limits.
 - .13 Enter/modify analog differentials.
- .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
- .6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
- .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
- .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.2**LOCAL CONTROL UNIT (LCU)**

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .3 Points integral to one Building System to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
 - .1 Include minimum 2 interface ports for connection of local computer terminal.
 - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

- .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
- .4 Include power supplies for operation of LCU and associated field equipment.
- .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
- .6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
 - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.
- .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

2.4 SOFTWARE

- .1 General.
 - .1 As existing.

2.5 LEVELS OF ADDRESS

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
 - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
 - .2 Update displayed analog values and status when new values received.
 - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
 - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.6 POINT NAME SUPPORT

- .1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

Part 3 Execution

3.1 LOCATION

- .1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

- .1 Install Controllers in secure locking enclosures as directed by Departmental Representative.
- .2 Provide necessary power from local 120 V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, low voltage current transformers.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING CONDITIONS

- .1 Cutting and Patching: in accordance with Section 01 73 00 - Execution Requirements supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 – 90 % RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
 - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
 - .3 Sensing element: hermetically sealed.
 - .4 Stem and tip construction: copper or type 304 stainless steel.
 - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.

- .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length as needed.
- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.
 - .1 LCD display to show space temperature and temperature setpoint.
 - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .3 Jack connection for plugging in laptop personal computer for access to zone bus.
 - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
 - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
 - .6 Stability 0.02 degrees C drift per year.
 - .7 Separate mounting base for ease of installation.
 - .2 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed stainless steel finish, with guard.
 - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm.
 - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
 - .3 Output signal: 4 – 20 mA into 500 ohms maximum load.
 - .4 Input and output short circuit and open circuit protection.
 - .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
 - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
 - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

- .8 Integral zero and span adjustments.
- .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.
- .10 Long term output drift: not to exceed 0.25 % of full scale/6 months.

2.4 PRESSURE TRANSDUCERS

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

2.5 STATIC PRESSURE SENSORS

- .1 Requirements:
 - .1 Multipoint element with self-averaging manifold.
 - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
 - .2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.6 STATIC PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 – 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
 - .3 Accuracy: 0.4 % of span.
 - .4 Repeatability: within 0.5 % of output.
 - .5 Linearity: within 1.5 % of span.
 - .6 Deadband or hysteresis: 0.1 % of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.7 TEMPERATURE SWITCHES

- .1 Requirements:
 - .1 Operate automatically. Reset automatically:
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1 degrees C.
 - .4 Snap action rating: as required. Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with protective guard as indicated.
 - .2 Duct, general purpose: insertion length = 460 mm.
 - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
 - .4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
 - .5 Strap-on: with helical screw stainless steel clamp.

2.8 ELECTROMECHANICAL RELAYS

- .1 Requirements:
 - .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
 - .3 Contacts: rated at 5 amps at 120 V AC.
 - .4 Relay to have visual status indication

2.9 CURRENT SENSING RELAYS

- .1 Requirements:
 - .1 Suitable to detect belt loss or motor failure.
 - .2 Trip point adjustment, output status LED.
 - .3 Split core for easy mounting.
 - .4 Induced sensor power.
 - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
 - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
 - .7 Adjustable latch level.

2.10 CONTROL DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.

- .2 Materials:
 - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
 - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
 - .3 Bearings: maintenance free, synthetic type of material.
 - .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
 - .5 Seals: synthetic type, mechanically locked into blade edges.
 - .1 Frame seals: synthetic type, mechanically locked into frame sides.
- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
 - .1 Size/Capacity: refer to damper schedule
 - .2 25 L/s/m² maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
 - .3 Temperature range: minus 40 degrees C to plus 100 degrees C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
 - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
 - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
 - .3 Install using manufacturers installation guidelines.
 - .4 Use same manufacturer as damper sections.

2.11 CONTROL VALVES

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

- .9 NPS 2 and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class 150 as indicated, valves to bear ANSI mark.
 - .3 Rangeability 100:1 minimum.

2.12 ELECTRONIC ACTUATORS

- .1 General
 - .1 Supply actuator with fastening devices as required.
 - .2 Actuator must be proportional with a working range between 0 and 10 V c.c. or between 4 and 20 mA c.c, depending on the case.
- .2 Control valve actuators
 - .1 All control valve actuators must be electronic DDC type. Except for terminal units, all control valve actuators must have a return spring to come back to their normal position on loss of power.
 - .2 Actuators for control valves for convectors may have modulating or electric or electronic floating control.
 - .3 With indication on measurement scale or on dial of the actual position of the valve.
- .3 Damper actuators
 - .1 Install in sufficient quantity to ensure proper operation any time. Select actuators according to operating pressures and damper dimensions. Install, on fresh air and on exhaust air dampers, actuators corresponding to a 50 % surface oversize.
 - .2 Actuators must be equipped with a return spring allowing dampers to return to their specified positions in case of a failure.
 - .3 Provide auxiliary contacts to confirm full opening and closing of dampers.

2.13 ELECTRICAL SWITCHES (I...)

- .1 General
 - .1 Sealed electrical switch, activated by an adjustable mechanism linked to a detection sensor.
- .2 Freezestat (IG)
 - .1 Anti freeze switch must open circuit when temperature falls below setpoint. Sensing element is 6 m (20') long and detects the lowest temperature point along the capillary length. Complete with manual reset device.

2.14 DAMPER POSITION DETECTORS (DPR)

- .1 Detector with a sealed SPDT switch with the mechanism activated by the blades of the damper.

2.15 CONVERTERS

- .1 Provide all the required converters in order to convert signals of different types. The converters must convert the signal from the transmitter into a signal compatible with the CNP or the signal from the CNP into a signal compatible with the controlled element.

2.16 ELECTRIC RELAY (RE...)

- .1 Plug in type with suitable mounting base. CSA approved and with sufficient contact capacity depending on application. Provided with dust proof casing and status light.
 - .1 Single pole relay, double throw (RESPDT);
 - .2 Double pole relay, double throw (REDPDT).
- .2 Time delay relays (RET...)
 - .1 They are CSA approved and they shall have sufficient contact capacity depending on application. Provided with dust proof casing;
 - .2 They are of sturdy construction c/w desired time adjustment;
 - .3 Primarily of two types:
 - .1 on delay (RETOD-);
 - .2 off delay (RETFD-).
- .3 Minimum position relay (REM...)
 - .1 0 to 100 % adjustable potentiometer with dial and appropriate controls.

2.17 Low voltage transformer

- .1 CSA approved 120/24 V, 60 Hz transformer with a coil of continuous copper conductor and high dielectric strength isolation.
- .2 Meet NEMA standards.
- .3 Include all transformers with sufficient capacity to insure a complete automatisisation of electromechanical systems.

2.18 IN DUCT FLOW METER

- .1 Characteristics:
 - .1 Operating temperature: -28 °C to 70 °C.
 - .2 Operating humidity: 0 to 99%.
 - .3 Reading precision: 2%.
 - .4 Insertion type meter with anodized gold sensor.
 - .5 Aluminium 6063 tubes, 28 mm diameter, with a stainless steel support, type 304.
 - .6 UL 873 certified.
 - .7 Coordinate meter's position as per manufacturer's recommendation and Departmental representative.

2.19 WIRING

- .1 In accordance with Section 26 27 10 - Modular Wiring System and 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG.
 - .2 Analog input and output: shielded #18 minimum solid copper.

2.20 VARIABLE FREQUENCY SPEED CONTROLLERS

- .1 Certifications
 - .1 Variable speed controllers shall be CSA or cUL approved.
 - .2 The complete unit including the cabinet, the speed controller and other components shall be CSA approved.
- .2 Manufacturer's shop drawings shall include:
 - .1 Dimensions and weights;
 - .2 Technical specifications;
 - .3 Wiring diagrams.
- .3 Type of load
 - .1 The load is made up of variable torque centrifugal fans.
 - .2 The speed controller shall operate adequately at all speeds. Verify the motor starting torque and running torque at different speeds.
 - .3 The speed controller shall be capable of starting the system when the system is in forward or reverse rotation, at any speed. Should the controller not be capable of starting the unit when in reverse rotation, install breaking resistors on the D.C. bus to prevent system rotation when not energized.
- .4 Cabinet
 - .1 Speed controller and bypass shall be installed in a NEMA 1 enclosure.
 - .2 The cabinet shall have ventilation slots with replacable filters to eliminate internal heat build-up.
 - .3 The cabinet shall be wall mount.
 - .4 It shall have hinged door with handle and lock and key.
 - .5 Equipped with disconnect switch complete with the possibility to lock the lever in the "open" position with padlocks.
 - .6 2-way selector "AUTO-OFF" which allows operation to be set as automatic control, or off-line for servicing.

- .7 The following components shall be shown on LCD display on the outer face of the door:
 - .1 “CONTROLLER RUNNING”;
 - .2 “CONTROLLER FAULT”;
 - .3 “MOTOR FAULT”;
- .5 Speed controller
 - .1 Input characteristics:
 - .1 Voltage : 600 V a.c. \pm 10 %;
 - .2 Number of phases : 3;
 - .3 Frequency : 60 Hz \pm 2 Hz;
 - .4 Input power factor minimum at any speed : 0.95;
 - .5 Efficiency : 0.95.
 - .2 Output characteristics
 - .1 Power : HP according to indications;
 - .2 Voltage : 575 V;
 - .3 Frequency : 0 to 120 Hz;
 - .4 Maximum carrier frequency : 2 kHz;
 - .5 Waveform type : PWM;
 - .6 Direct current : 100 %;
 - .7 One minute peak current : 110 %.
 - .3 The unit to be of the programmable microprocessor type with control panel and alphanumeric display.
 - .4 The following functions to be programmable:
 - .1 Starting and running frequencies;
 - .2 V/Hz ratio;
 - .3 Acceleration/deceleration;
 - .4 Overvoltage;
 - .5 Speed.
 - .5 The following information to be displayed:
 - .1 Output voltage;
 - .2 % load;
 - .3 % speed;
 - .4 Ready to start;
 - .5 Operation in automatic mode or local mode.
 - .6 Unit protected against the following events which are displayed on the alphanumeric panel:
 - .1 Loss of phase;
 - .2 Under voltage;
 - .3 Over voltage;

- .4 Overload;
 - .5 Short circuit;
 - .6 Ground fault;
 - .7 Overheating;
 - .8 Internal component failure.
- .7 Environmental operating conditions:
 - .1 Ambient temperature : 0 to 40 °C (32 to 104 °F);
 - .2 Relative humidity (non condensing) : 20 to 90% R.H.;
 - .3 Altitude : 3300 feet (1000 m).
- .6 Inductors
 - .1 A 3% smoothing inductor on the d.c. bus and a 5% input inductance shall be supplied on all variable speed drives. Shunt type filters shall not be accepted. The total current harmonic distortion not to exceed 30% at the a.c. input of each speed controller.
 - .2 In order to reduce the wave reflexion between the controller and the motor, a 3% inductor shall be installed at the output of the speed controller if the motor is installed more than 10 m away from speed controller. Make standing wave tests and supply a written report showing the wave shapes on an oscilloscope with or without the inductor.
- .7 Control signals
 - .1 The following control elements stop the motor when the speed controller drives it. Provide the necessary control circuits:
 - .1 Signal from the control panel:
 - .1 Start/stop signal.
 - .2 Protection elements directly connected to the speed controller:
 - .1 Motor thermistors (Thermistor trip circuits to be compatible with the motor thermistors);
 - .2 Fire alarm contact;
 - .3 Other external protections (frost detection, disconnect auxiliary contact closing).
 - .2 The speed controller accepts the 0 to 10 V d.c. or 4 to 20 mA speed signal from the control panel and communicates with the control panel according to the existing protocol.
 - .3 The following signals shall be transmitted to the control panel:
 - .1 Speed;
 - .2 Output frequency;
 - .3 Unit fault contact;
 - .4 Proof of operation contact obtained by a current reading on one phase of the motor circuit.
- .8 Acceptable products:
 - .1 ABB, ACH 550;

- .2 Siemens, SED2;
- .3 Danfoss, VLT;
- .4 Trane, TR200;
- .5 Allen-Bradley, Power Flex;
- .6 Yaskawa, P1000 or Z1000.

Part 3 Execution**3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .7 Pneumatic: provide Pneumatic tubing, valves and fittings for field control devices in accordance with Section 23 09 43 - Pneumatic Control System for HVAC.
- .8 Mechanical: supply and install in accordance with Section 23 09 43 - Pneumatic Control System for HVAC.
 - .1 Pipe Taps.
 - .2 Wells and Control Valves.
 - .3 Air flow stations, dampers, and other devices.

3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

- .3 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.
 - .2 Install in NEMA 4 enclosures.
- .4 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.3 MAGNEHELIC PRESSURE INDICATORS

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.
- .2 Locations: as indicated.

3.4 PRESSURE SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
 - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.5 IDENTIFICATION

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

3.6 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

3.7 VARIABLE FREQUENCY DRIVES

- .1 Installation
 - .1 The VFD must be installed according to the manufacturer's recommendations, as stated in the installation guide;
 - .2 Electrical cable must be install according to the VFD manufacturer recommendations, as stated in the installation guide;
 - .3 Install the wall-mounted variable frequency drive on plywood mounted on steel profiles attached to the floor and to the building structure;
 - .4 Attach the variable frequency drives to the floor with 40 mm (1½") steel profiles.
 - .5 Connect all the required control circuits to the drives;
 - .6 Connect all interlocks and local protections to ensure that they are functional both under normal operation and on bypass operation;
 - .7 Program and adjust the drive settings according to the Engineer recommendations;
 - .8 Provide a means to lock out near the motor if the speed controller's installation safety distance with the motor is exceeded;
 - .9 Provide AutoCad plans of the connections of the speed controllers to the existing infrastructure. Permanently number all wires which are related to the control diagrams.
- .2 Tests
 - .1 The Contractor will include all necessary costs and make arrangements with the distributor to proceed with the verification and commissioning of the speed controllers for every motor according to the "Variable frequency drive test" table found in the appendix;
 - .2 Prior to testing, the Engineer must be provided with the calibration certificates of every equipment to be used. Tests will be cancelled and new ones will need to be done to the Contractor's charge if there is a default in providing the certificates;
 - .3 All tests must be coordinated with the intervener's of divisions 23 and 26;
 - .4 Execute motor wave reflection tests with an oscilloscope that can produce a paper copy of the waveform. Submit the results to the Engineer;
 - .5 Measure harmonic distortion of the incoming current to every drive to ensure that the 30% threshold is not exceeded. Execute this test, one drive at a time, at 30%, 50%, 65%, 80% and 100% of the normal motor speed;

- .6 Once all tests are completed, a report will need to be prepared and signed. The report must include a conclusion covering the results obtained and the corrections made, and must certify the installations as well as the speed controllers' compliance with the manufacturer's requirements. An electronic copy must be provided to the Engineer.
- .3 Product support
 - .1 Well-trained support personnel and application engineers who are familiar with the VFD must be locally available and be able to offer service in no more than four (4) hours;
 - .2 A 24 hours a day support line must also be available 365 days a year.
 - .3 A computerized training on CD must be handed to the Owner at project completion. This training must include the following elements: installation, programming and utilization of the VFD, bypass and BACnet communication functions and devices.
- .4 Warranty
 - .1 Warranty period must last 24 months after the certified start-up date and a maximum of 30 months after the shipping date. This warranty ensures reimbursement of on-site parts and labor work. A 24 hours a day support line must also be available 365 days a year.

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
 - .1 Control Description Logic (CDL) for each system.
 - .2 Input/Output Point Summary Tables for each system.
 - .3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.2 REFERENCES

- .1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.
 - .1 MD250005 – Energy monitoring and control systems (EMCS) design guidelines.

1.3 SEQUENCING

- .1 Present sequencing of operations for systems, in accordance with MD250005 – Energy monitoring and control systems (EMCS) design guidelines.
- .2 Sequencing of operations.
 - .1 Kitchen hood and dishwasher
 - .1 Refer to kitchen services requirements for prescriptions.
 - .2 Obtain the following points from the hood control panel for interaction with the air handling unit and the exhaust fans:
 - .1 No. 101 kitchen hood operation and modulation signal (VE4-HOT-002, VE5-HOTA-002 & VE6-HOTB-002).
 - .2 No. 102 air handling unit operation and modulation signal.
 - .3 No. 122 Ventilation request (dishwasher).
 - .4 No. 123 dishwasher operation signal (VE3-LAV-002).
 - .2 Ventilation – sanitary evacuation (typical)
 - .1 System off:
 - .1 Evacuation fan is off.
 - .2 System start and Normal operation:
 - .1 In normal operation, system is continuously on.

- .3 Local Protection:
 - .1 N/A.
- .4 Alarm :
 - .1 Fan fault is transmitted to CU.
 - .2 Lost of run status for more than two (2) minutes.
- .3 Cold rooms centralisation
 - .1 Report the temperature alarm to the EMCS.
- .4 Split system
 - .1 Connect the wall thermostat, evaporators and condensers as per manufacturer's instruction.
- .5 Kitchen air handling unit
 - .1 Refer to the points description required for the kitchen and dishwasher exhaust fans and the operation from the kitchen control panel (E311).
 - .2 System off:
 - .1 Supply and exhausts fans are off.
 - .2 Outdoor air damper is closed
 - .3 Return air damper is open.
 - .4 RC2-1 valve is closed
 - .5 The face and bypass damper is in bypass position
 - .3 System start:
 - .1 In normal operation, system is continuously on with the outdoor damper in minimum position and the return damper in maximum position.
 - .4 Normal operation:
 - .1 Outdoor and return dampers are modulated to maintain the return flow required to keep the room pressure with the exhausts fans.
 - .1 Night mode:
 - .1 Sanitary evacuation only (276 L/s)
 - .2 Outdoor Air: 248 L/s
 - .3 Return Air (flowmeter's reading): 4000 L/s.
 - .2 Occupied Mode:
 - .1 Evacuation:
 - .1 Sanitary 276 L/s (always on)
 - .2 Dishwasher hood: 1133 or 0 L/s (on or off)
 - .3 Kitchen hood: 990 to 3300 L/s (variable)
 - .2 Outdoor Air: 90% of the evacuation sum

- .3 Return Air (flowmeter's reading) : 4247 L/s –
« Outdoor Air »
- .2 For an exterior temperature below 4 °C
 - .1 RC2-1 control valve is in open position
 - .2 The face and bypass damper is modulated by the CU to maintain an ambient temperature of 20°C.
- .3 For an exterior temperature equal or higher than 4 °C
 - .1 The face and bypass damper is in the face position
 - .2 RC2-1 control valve is modulated by the CU to maintain an ambient temperature of 20°C
- .5 Local Protection:
 - .1 Upon freeze detection, the face and bypass damper is in bypass position, RC2-1 is on open position and the fan's motor is stopped by electrical interlock
 - .2 Air handling and exhaust fans are linked and stopped, upon fire alarm detection, as per kitchen control panel's requirement.
- .6 Alarm:
 - .1 Fan fault is transmitted to CU.
 - .2 Filter static pressure lost is transmitted to CU.
 - .3 Freeze detection is transmitted to the CU.
 - .4 Supply temperature is transmitted to the CU.
 - .5 Alarms are sent when variables exceed their limits:
 - For an exterior temperature below 20°C, when the ambient temperature: $SP \pm 2^{\circ}\text{C}$;

Part 2 Products**2.1 NOT USED****Part 3 Execution****3.1 NOT USED****END OF SECTION**

Part 1 General**1.1 REFERENCES**

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 CSA Group
 - .1 CSA C22.1, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2.
 - .3 CAN/CSA-C22.3 No.1, Overhead Systems.
 - .4 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .3 The current edition of reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review single line electrical diagrams under plexiglass and locate as indicated.
 - .1 Electrical distribution system in main electrical room.
- .4 Submit for review fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .5 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

- .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .5 If changes are required, notify Departmental Representative of these changes before they are made.
- .6 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .7 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.

- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials and equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in French.
- .4 Acceptable materials or products:
 - .1 When material or products prescribed by their trademark, consult the instructions to Tenderers in order to know the procedure for the application for material or substitute approval.
- .5 Areas protected by sprinklers
 - .1 Except otherwise noted, the building is protected by an automatic fire extinguishing system (water sprinklers).
 - .2 All electrical equipment having openings for ventilation, bus duct connection, etc., shall be designed for installation in sprinkler protected rooms. This applies, among others, on transformers, distribution centers, sub-stations, etc.

- .3 The construction and installation of equipment shall prevent the water from sprinkler system to penetrate into the equipment and touch live parts or components.
- .4 Insure that water coming from sprinkler system which could remain on top equipment cannot enter inside the panel box by openings for penetration of conduits, cables, bus ducts, etc. Use watertight connectors. Seal all penetrations on top of electrical apparatus.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Departmental Representative.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Unless there is already another existing method in place for the establishment, which in this case must be followed, identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: plastic laminate 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

- .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. [____]" as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: should indicate the following information:
- .1 Top: identification load apparatus (except for panels an motor control centers: no identification) « P-0011 »;
 - .2 Center: equipment identification « T-0011 »;
 - .3 Bottom: identification of source apparatus « PD-0011 ».
- .8 Transformers: indicate capacity, primary and secondary voltages.
- .9 120/208 V and 600 V service panels.
- .1 Identify each panel circuit in the typewritten schedule inserted in a plastic holder on the inside of the panel door. The circuit numbers shall be those shown on the drawings. Theses schedules shall be included in the operation and maintenance manuals.
 - .2 For modified electric panels, supply a new updated typewritten list.
- .10 Outlets and lighting switch
- .1 Identify all service outlets with a self-adhesive marker showing the panel and circuit numbers on the outside plate surface.
 - .2 The adhesive marker shall be similar to Brother's P-Touch 2000. It shall have black lettering on clear substrate, normal 16 points lettering.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.

- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

- .4 When the boxes are located in an unfinished space as ceiling space, paint junction boxes side with specified colour, except cover. With a permanent marker, identify cover the source (panelboard) and circuit(s) number(s) of all wiring going through the boxes.

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical rooms on latch side of floor.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at heights shown on drawings unless indicated otherwise.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 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 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.9 SYSTEM STARTUP

- .1 Instruct Departmental Representative in operation, care and maintenance of systems, system equipment and components.

- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.11 SEISMIC PROTECTION

- .1 General
 - .1 Contractor is responsible to evaluate, furnish and install seismic protection for all technical components installed under his responsibility.
 - .2 Hire an Engineer, member in good standing of the Ordre des ingénieurs du Québec, for the evaluation of the seismic risk and calculation of seismic force resisting systems. The hired Engineering shall demonstrate recognized expertise in seismic protection. Contractor shall provide his contact details no more than two (2) weeks after contract signature.
 - .3 During an earthquake, seismic protection devices shall prevent permanent displacements and damages caused by vertical and horizontal motions and overturns.
- .2 Design criterias
 - .1 Site class of the building is F.
 - .2 Height of building
 - .1 See architectural drawing.
- .3 Evaluation and mitigation of seismic effects
 - .1 Evaluation of seismic effects shall be done as per requirements of sub-section 4.1.8 of the Code de construction du Québec 2010, Chapter 1 (CNB 2010 et modifications du Québec).
 - .2 Seismic force resisting systems shall be designed as per following standards:
 - NFPA 13 et 20;
 - SMACNA – Seismic Restraint Manual Guidelines for Mechanical System;
 - ASHRAE – Seismic and Wind Design;
 - FEMA;

- Engineering documents from earthquake-resistant devices manufacturers.
- .4 Evaluation and mitigation of seismic effects report
- .1 Submit to the Engineer the evaluation and mitigation of seismic effects report before beginning the installation of the technical components.
- .2 The report shall include, at least, the following information:
- .1 General data for the project:
- Location of the building;
 - General description of the building including height of the building (hn);
 - Site class at the location of the building;
 - Importance category of the building;
 - Value of S_a (0.2);
 - Value of F_a ;
 - Value of I_e ;
- .2 List of all technical components included in the contract which need to have an evaluation of the seismic effects.
- .3 List of all technical components which may be exempted with the justifications.
- .4 For each technical component (CT) the evaluation of the seismic effect and the seismic force resisting system applied. Include following elements:
- Identification of the CT as per drawings and specifications;
 - Location of the CT including height (hx);
 - Description of CT including:
 - Type of equipment;
 - Make and model;
 - Dimensions;
 - Weight;
 - Category and values of C_p , A_r et R_p .
 - Calculation of lateral force V_p , and forces on building structure;
 - Description of the resisting system applied, including:
 - Make and model of chosen material;
 - Installation drawing specific for this project;
 - Drawing showing the location of the seismic resisting systems.
- .5 For each CT located on the ground, on a slab or on an equipment base, the overturn force calculation and description of the resisting system. Included following elements:
- Identification of the CT as per drawings and specifications;
 - Location of the CT including height (hx);
 - Description of CT including:
 - Type of equipment;
 - Make and model;
 - Dimensions;

- Weight;
- Location of gravity center;
- Calculation of the overturn force;
- Description of the resisting system applied, including:
 - Mark and model of chosen material;
 - Installation drawing specific for this project;
 - Drawing showing the location of the seismic resisting systems.

.5 Installation

- .1 Install seismic force resisting system as per the indications of the evaluation and mitigation of seismic effects report.
- .2 Any modification to the seismic force resisting system for any reason, shall be subject to a new calculation by the Engineer responsible for the seismic protection, and issued as an amendment to the report.
- .3 Following requirements apply to the installation of electrical and mechanical material:
 - Power-driven and drop-in anchors are not permitted for traction loads;
 - C-clamps are not allowed to support CT unless they have a retainer mechanism;
 - C-clamps are not allowed for seismic resisting systems;
 - Equipment base shall be anchored to the slab;
 - All vibration isolators shall be designed for seismic protection;
 - Oval bolt adjusting hole are prohibited.

.6 Work approval

- .1 The Engineer who prepared the evaluation and mitigation of seismic effects report shall inspect the work related to the seismic force resisting systems.
- .2 Obtain from the seismic protection engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and the amendments to the report. Submit this certification before submitting of the work certificate of compliance.
- .3 Include in the operation and maintenance manual all documents issued by the seismic protection engineer.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 CSA International CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.
 - .1 CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)
- .4 The current edition of reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 MATERIALS**

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable and TECK cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE. 1000 V insulation for upstream and downstream conductor of variable frequency drive.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: , 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminium.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at adequate spacing.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.

- .3 Armour: interlocking type fabricated from aluminium strip.
- .4 Connectors: anti short connectors.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by hangers.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.
 - .1 AC90 or BX cable usage is permitted on maximum 3 m length only in the following cases :

- .1 Connections of recessed or surface-mounted lighting fixtures, to junction box in ceiling.
- .2 Verticals runs inside wall for wiring devices connection, to junction box in ceiling.
- .3 Daisy chain connection type is prohibited.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 The current edition of reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Rod electrodes: galvanized steel 19 mm diameter by minimum 3 m long.
- .3 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.

- .4 Insulated grounding conductors: green, copper conductors, size as indicated.
- .5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor to outdoor lighting standards.

- .10 Connect building structural steel and metal siding to ground.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Ground secondary service pedestals.

3.3 ELECTRODES

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Install rod electrodes and make grounding connections.
- .4 Bond separate, multiple electrodes together.
- .5 Use copper conductors for connections to electrodes as indicated.
- .6 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.6 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.

3.7 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, security systems, intercommunication systems as indicated.

3.8 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hangers and supports from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at appropriate intervals.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, 20th Edition.
- .2 The current edition of reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products**2.1 SPLITTERS**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Construction:welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

Part 3 Execution**3.1 SPLITTER INSTALLATION**

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION AND PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, 20th Edition.
- .2 The current edition of reference should always be used.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples for floor box in accordance with Section 01 33 00 - Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single or multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single or multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).
- .2 The current edition of reference should always be used.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic waste in designated containers.
- .2 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products**2.1 CABLES AND REELS**

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.

- .3 Identify cables for exclusively dc applications.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, steel liquid-tight flexible metal.

2.3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at appropriate spacing.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 21 mm deflection.
- .2 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene.

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 datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.

- .3 Use rigid galvanized steel threaded conduit outside building.
- .4 Use electrical metallic tubing (EMT) inside building except in cast concrete.
- .5 Use rigid pvc conduit underground and corrosive locations.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations and in cold rooms of freezers.
- .7 Use liquid tight flexible metal conduit for direct connection of kitchen equipment.
- .8 Minimum conduit size for lighting and power circuits: 21 mm.
- .9 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 21 mm diameter.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .14 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .15 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.8 CLEANING

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

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).
 - .2 CSA C9, Dry-Type Transformers.
 - .3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)
- .3 The current edition of reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 DESIGN DESCRIPTION**

- .1 Design .
 - .1 Type: ANN.
 - .2 Single or 3 phase, power and voltage as indicated, 60 Hz.

- .3 Voltage taps: standard.
- .4 Insulation: Class H (220), 150 degrees C temperature rise.
- .5 Basic Impulse Level (BIL): standard.
- .6 Hipot: standard.
- .7 Average sound level: standard
- .8 Impedance at 17 degrees C: standard
- .9 Enclosure: CSA, removable metal front panel.
- .10 Mounting: floor or wall.
- .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .12 Copper windings.
- .13 Voltage Regulation to be 4% or better.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.
- .3 Nameplate wording: as indicated on drawings.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for dry type transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Concrete bases are required under the transformers laid on floor. Concrete bases required to rest the equipment have 100 mm height and exceed the equipment on all side by 50 mm and 150 mm at supports and springs and have chamfered edges.
- .4 Ensure adequate clearance around transformer for ventilation.
- .5 Install transformers in level upright position.
- .6 Remove shipping supports only after transformer is installed and just before putting into service.

- .7 Loosen isolation pad bolts until no compression is visible.
- .8 Make primary and secondary connections in accordance with wiring diagram.
- .9 Energize transformers after installation is complete.
- .10 Make conduit entry into bottom 1/3 of transformer enclosure.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.29, Panelboards and Enclosed Panelboards.
- .2 The current edition of reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.

- .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 and 600 V panelboards: bus interrupting capacity, same as breakers.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Isolated ground bus.
- .12 Include one ground bus with three (3) terminals to link corresponding conductor to the breakers capacity of panelboards.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 In 120 or 208 Volts circuits use, unless otherwise noted on the distribution diagram or on the panel description sheets, single, two or three pole circuit breakers having the ratings as shown and with a 10 kA minimum RMS, symmetrical rupturing capacity.
- .4 In 347 or 600 Volts circuits use, unless otherwise noted on the distribution diagram or on the panel description sheets, single, two or three pole circuit breakers having the ratings as shown and with a 14kA minimum RMS, symmetrical rupturing capacity.
- .5 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .6 Lock-on devices for fire alarm, emergency lighting, door supervisory, intercom, stairway lighting, exit and CCTV circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative. Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits. Refer to panelboard description at the end of present section.
- .5 Connect neutral conductors to common neutral bus.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

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

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 CSA International
 - .1 CSA C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55, Special Use Switches.
 - .4 CSA C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20).
- .2 The current edition of reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 SWITCHES**

- .1 15, 20 A, 120 V, 347 V, industrial grade, single pole, double pole, three-way or four-way switches as indicated to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, industrial grade to: CSA C22.2 No.42 with following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices:
 - .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic flush type.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, vertically brushed, 1 mm thick cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.

- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded cover plates complete with gaskets for single receptacles or switches.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 60 A. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in moisture free location.

1.3 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Three spare fuses of each type and size installed above 100 A.
- .3 Six spare fuses of each type and size installed up to and including 100 A.

Part 2 Products

2.1 FUSES - GENERAL

- .1 Fuse type references J1 and J2, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

- .1 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type J2, fast acting.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.

- .2 Ensure correct fuses fitted to physically matched mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Fusible type
 - .1 Motors and transformers circuits
 - Class J, form 1, time delayed.
 - .2 Other circuits
 - 0 to 600 A: Class J, form 1, quick action.
 - 601 to 2000 A: Class L, form 1, quick action.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 CSA International
 - .1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE).
- .2 The current edition of the references should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.

- .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title;
 - .2 End user's reference number, and
 - .3 List of circuit breakers.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .5 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as following :
 - .1 In 120 or 208 Volts circuits use, unless otherwise noted on the distribution diagram or on the panel description sheets, single, two or three pole circuit breakers having the ratings as shown and with a 10 kA minimum RMS, symmetrical rupturing capacity.
 - .2 In 347 or 600 Volts circuits use, unless otherwise noted on the distribution diagram or on the panel description sheets, single, two or three pole circuit breakers having the ratings as shown and with a 14kA minimum RMS, symmetrical rupturing capacity.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied .

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 CSA International
 - .1 CAN/CSA C22.2 No.144, Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.
- .3 The current edition of the reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for ground fault circuit interrupters for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect ground fault circuit interrupters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 MATERIALS**

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144.
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 GROUND FAULT PROTECTOR UNIT

- .1 Self-contained with 15 A, 120 V circuit interrupter and duplex receptacle complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 CSA Enclosure 1, surface mounted with stainless steel face plate.
 - .4 Industrial grade.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault circuit interrupters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Arrange for field testing of ground fault equipment by Contractor before commissioning service.
- .2 Demonstrate simulated ground fault tests.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMJ-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.
- .2 The current edition of references should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 DISCONNECT SWITCHES**

- .1 Fusible and non-fusible, as indicated, disconnect switch in CSA enclosure 1, to CAN/CSA-C22.2 No.4 size as indicated.
- .2 Provision for padlocking in on-off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.

- .5 Fuseholders: to CSA C22.2 No.39, suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.
- .8 Safety switches in the circuit between a motor and a variable frequency drive shall be fitted with one type C auxiliary contact. Connect this contact to the variable frequency drive with two (2) # 14 AWG conductors inside a 16 mm (½") conduit.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.14, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.
- .3 The current edition of the references should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for contactors and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect contactors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

- .4 Mount in CSA Enclosure 1 unless otherwise indicated.
- .5 Include following options in cover:
 - .1 Green indicating lamp.
 - .2 Stop-Start pushbutton.
 - .3 Hand-Off-Auto selector switch.
 - .4 On-Off selector switch.
- .6 Control transformer, factory wired and installed in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Size 4 nameplate indicating name of load controlled as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with 26 05 00 - Common Work Results for Electrical.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.3 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.14, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1, Industrial Control and Systems: General Requirements.
- .3 The current edition of the references should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Include schematic, wiring, interconnection diagrams.

1.3 QUALITY ASSURANCE

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for control devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control devices from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PROGRAMMABLE TIMER FOR LIGHTING

- .1 Digital timer, programmable 7 days, to switch « On/Off » kitchen lighting sector through multi-pole contactors.
- .2 Operation voltage of the control part of the timer must be consistent with the contractor control coil.

2.2 COUNT-DOWN TIMER FOR LIGHTING

- .1 Manual count-down on 60 minutes period.
- .2 By-pass the programmable timer to turn « On » lighting for 60 minutes period outside of scheduled times.
- .3 Count-down timer will be connected in parallel with the programmable timer on control circuit of lighting.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install control devices, make interconnections.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Check out complete system for operational sequencing.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 International Electrotechnical Commission (IEC)
 - .1 IEC 947-4-1, Part 4: Electromechanical contactors and motor-starters.
- .2 The current edition of reference should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout and components.
 - .4 Enclosure types.
 - .5 Wiring diagram.
 - .6 Interconnection diagrams.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.
- .3 Extra Materials:
 - .1 Provide listed spare parts for each different size and type of starter.
 - .1 3 contacts, stationary.
 - .2 3 contacts, movable.
 - .3 1 contacts, auxiliary.
 - .4 1 control transformer.
 - .5 1 operating coil.
 - .6 2 fuses.
 - .7 3 indicator lights.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MATERIALS

- .1 Starters: EEMAC/NEMA and CSA standards.

2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type, rating, and enclosure type 1, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 One overload heater, manual reset, trip indicating handle.
 - .3 Toggle switch: heavy duty labelled as indicated.
 - .4 Indicating light: heavy duty type and colour as indicated.
 - .5 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector switches: heavy duty labelled as indicated.
 - .2 Indicating lights: heavy duty type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 ACCESSORIES

- .1 Pushbutton: heavy duty.
- .2 Selector switches: heavy duty.
- .3 Indicating lights: heavy duty.

2.6 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.7 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC).
- .7 The current edition of references should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval by Departmental Representative.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and maintenance.

1.3 QUALITY ASSURANCE

- .1 Provide mock-ups in accordance with Section 01 45 00 - Quality Control.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.
- .5 Disposal of old PCB filled ballasts.

Part 2 Products**2.1 LAMPS**

- .1 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid-start, 4100 K, 30,000 hour lamp life, 2950 initial lumens, CRI 80; or as indicated.

2.2 BALLASTS

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic and IC electronic dimmable or as indicated.
 - .1 Rating: voltage as indicated 120 V, 60 Hz, for use with 32W, rapid start lamps.
 - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
 - .3 Power factor: minimum 95% with 95% of rated lamp lumens.
 - .4 Current crest factor: 1.7 maximum.
 - .5 Harmonics: 10% maximum THD.
 - .6 Operating frequency of electronic ballast: 20 kHz minimum.
 - .7 Total circuit power: 62 Watts.
 - .8 Ballast factor: greater than 0.90.
 - .9 Sound rated: Class A.
 - .10 Mounting: integral with luminaire.
 - .11 5-years warranty regardless of annual operating time and allowance \$25 per ballast for labour when Owner replaces the defective ballast. If ballast no longer meets the specifications set forth in this section or can not operate the lamps according to applicable ANSI, it is deemed defective.

2.3 LIGHT EMITTING DIODE DEVICES (LED)

- .1 Reference Standards - Devices
 - .1 Photometric tests in accordance with IES LM-79 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
 - .2 Light depreciation determined according to IES LM-80 Approved Method: Measuring Lumen Maintenance of LED Light Sources.
 - .3 Long-term light depreciation determined according to IES TM-21 Projecting Long Term Lumen Maintenance of LED Light Sources.

- .4 UL 8750 Light Emitting Diode Equipment for Use in Lighting Products.
- .2 Reference Standards – Drivers
 - .1 UL 1310 Class 2 Power Units or equivalent CSA.
 - .2 ANSI C62.41 Category A IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - .3 FCC Title 47 CFR Part 18 *Electronic Code of Federal Regulations – Telecommunication – Industrial, Scientific, and Medical Equipment.*
- .3 All LED devices and their components must, at minimal meet all reference standards listed above.
- .4 Each fixture must be equipped with a compatible factory installed driver. Everything must be approved for plenum use.
- .5 Supply units shall be equipped with colour connectors determined in accordance with the standard requirements ANSI C82.11.
- .6 Driver technical data:
 - .1 120 V \pm 5 %, 60 Hz.
 - .2 Power factor: 90 % minimum.
 - .3 Total harmonic distortion: 20 % maximum.
 - .4 Class A nominal sound volume.
 - .5 Operation ambient temperature: 10 to 40 °C, 90 % R.H.
 - .6 The housing temperature: 0 at 62 °C, 90 % H.R.
 - .7 Must tolerate without damage a condition of open circuit or short circuit without of fuses or other external protection devices.
 - .8 Must not contain any PCB.
- .7 For dimming to line voltage applications, the contractor must ensure compatibility between drivers and dimmers.
- .8 Minimum 5 year warranty, parts and labor, for the device. This includes, without limitation, diodes, connectors, driver and all other components necessary for the proper functioning of the device.

2.4 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.5 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule.

2.6 LUMINAIRES

- .1 As indicated in luminaire schedule.

- .2 All new fixtures, regardless of voltage, must be equipped with unplug type connector (as per electrical code) for connection to ballast. The connector must permit to work securely on fixture or ballast.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling and attached to the structure to remain horizontally at the same level. The method of attachment must be proposed by the contractor and approved by Departmental Representative.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141, Emergency Lighting Equipment.
- .2 The current edition of the references should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 60 months.

Part 2 Products

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.

- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: V DC as required.
- .4 Operating time: 60 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON'.
- .10 Lamp heads: integral on unit or remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: as indicated.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: standard color.
- .13 Auxiliary equipment:
 - .1 Test switch.
 - .2 AC input and DC output terminal blocks inside cabinet.
 - .3 Shelf, bracket.
 - .4 Cord and plug connection for AC.

2.2 WIRING OF REMOTE HEADS

- .1 Conduit: type EMT, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: RW90 type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized as required.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
 - .2 CSA C860, Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101, Life Safety Code.
- .3 The current edition of the references should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

Part 2 Products

2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: as indicated.
- .3 Face and back plates: as indicated.
- .4 Lamps: LED, 120 V, over 500,000 hours.
- .5 Downlight: white glass in bottom of unit.
- .6 Face plate to remain captive for relamping.
- .7 The exit signs will be connected to both 120 V power and D.C. circuit from emergency lighting.

2.2 DESIGN type « X »

- .1 Wall or ceiling mounting.

- .2 Single or double face as indicated.
- .3 Arrow: right or left or both directions, as indicated.

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 datasheets.

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits and to emergency lighting (battery).
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

3.3 CLEANING

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

END OF SECTION

PART 1 - BACKGROUND

- 1.1 Related sections
- .1 Section 01 74 19 - Construction/Demolition Waste Management And Removal.
 - .2 Section 26 05 34 - Conduits, Fittings and Conduit Connectors as regards conduits.
- 1.2 Reference Documents
- .1 Correctional Service of Canada – Department of Technical Services – Electronic Systems
 - .1 SE/ET-0101 Electronic Engineering Statement of Work – Purchase and Installation of Electronic Security Systems.
 - .2 SE/ET-0102 Electronic Engineering Statement of Work – Quality Control of Electronic Security System Purchase and Installation Actions.
- 1.3 Reference Standards
- .1 Canadian Standards Association (CSA)/CSA International.
 - .2 EIA-310-D Electronic Industry Association Standard for Racks, Panels and Associated Equipment.
 - .3 Underwriters' Laboratories (UL)
 - .1 UL 294-2009, Access Control System Units.
 - .2 UL 1076-2005, Safety for Proprietary Burglar Alarm Units and Systems.
 - .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S316-14 Standard for Performance of Video Surveillance Systems.
- 1.4 Definitions
- .1 UPS Uninterruptible Power Supply
 - .2 CSA Canadian Standards Association
 - .3 EIA Electronic Industries Association
 - .4 CSC Correctional Service of Canada
- 1.5 Performance Requirements
- .1 All wiring, cable and connectors shall be labelled at both (2) ends and shall carry the same number in printed characters at both ends using a permanent marking method that is water, solvent, and oil-resistant.
 - .2 Conductors that supply power to equipment shall not be subject to loads in excess of 80% their rating.
 - .3 No cable that is inferior to the manufacturer's recommendations shall be used.
 - .4 Based on the location of the cable, no cable shall be below the requirements of Schedule 19 of the Québec Construction Code, Chapter V - Electricity.

1.6 Documents/Samples to be Submitted

- .1 Documentation Specifications
 - .1 All final supporting documentation supplied regarding cable shall be accompanied by a relevant waiver of copyright.
 - .2 Documentation shall comply with the requirements of Statement of Work SE/ET-0101.
- .2 Preliminary Design:
 - .1 The reference preliminary design plan shall be drawn up subsequent to the review and approval of the Preliminary Design Report (PDR) by the head of design or his or her representative. This plan will include specifications, drawings, and the approved PDR.
 - .2 Contractor shall prepare and submit two (2) copies of the PDR to the head of design and one (1) copy to the contracting authority at least ten (10) days prior to the PDR review meeting. The PDR shall include:
 - .1 Performance specifications, including the flow diagrams for the proposed system. The technical analysis and data on the performance of the equipment shall facilitate confirmation of the system's specifications;
 - .2 Preliminary equipment drawings, including control panels and hardware racks;
 - .3 The list of standard equipment including the part number, model number, manufacturer's name and the quantity of each item;
 - .4 The list of custom-built equipment, including the model and the quantity of each item;
 - .5 The flow diagrams for all custom-built equipment;
 - .6 The design drawings for all custom-built equipment;
 - .7 The proposed product insurance plan;
 - .8 The proposed maintenance plan;
 - .9 The proposed spare parts provisioning plan;
 - .10 The proposed training plan;
- .3 Preliminary design review:
 - .1 The Contractor shall be responsible for organising the meeting to review the contents of the PDR. The Contractor shall provide the space for the meeting as well as all necessary facilities. The head of design shall identify any part of the PDR that does not comply with CSC requirements.
- .4 Final Design:
 - .1 The final reference design plan shall be drawn up subsequent to the review and approval of the Final Design Report (FDR) by the head of design. It will serve as the basis for the control of all changes made to the design and performance of the equipment. The FDR shall include:
 - .1 All the information included in the reference preliminary design

- plan;
- .2 Models of the control panel, ergonomic considerations, etc. as needed;
- .3 Drawings and operational descriptions for custom-built equipment, including interface specifications;
- .4 Installation diagrams and instructions;
- .5 Model and updated availability analysis based on the final design of the system and the selected hardware.

- .2 The FDR shall be drawn up in accordance with recommended industry standards. Two (2) copies of the FDR shall be submitted to the head of design at least ten (10) days prior to the FDR Review Meeting.

.5 Final Design Review:

- .1 A meeting to examine the contents of the FDR shall be held. The Contractor shall provide the space for the meeting as well as all necessary facilities. All contractor staff responsible for the engineering design of the system/hardware shall be available to attend the review.

1.7 Warranty

- .1 The warranty shall cover all equipment and shall include the costs of labour as well as the equipment and supplies needed for the following services:
 - .1 Replacement and repair of defective parts;
 - .2 Technical support for any additions.
- .2 During the warranty period, should one or more devices associated with the different systems break down, service personnel shall be reachable 24 hours a day/7 days a week. Said service personnel shall travel to the site and locate the source of the problem within 4 hours of receiving the service request; they shall then repair the problem as soon as practicable in order to keep disruption of Client's operations or of the level of system security to a minimum.
- .3 Contractor shall keep the necessary quantity of spare parts in inventory to comply with the specified requirements.
- .4 If a manufacturer offers a warranty on an equipment item for a period of time that is longer than that specified in the General Terms and Conditions, Contractor shall transfer such warranty to the system's end-user.
- .5 The warranty shall not be less than one year from the date of acceptance of the work.

PART 2 - PRODUCTS

2.1 Supplies/Equipment

- .1 Outdoor conduits shall be included in the contract unless otherwise indicated on the drawings.
- .2 Indoor conduits shall be included in the contract unless otherwise indicated on the drawings.
- .3 120-volt AC electricity distribution between the electrical panel and the junction box or the plug contact shall be included in the contract.
- .4 120-volt AC electricity distribution between the safety devices and the junction box or the plug contact shall be included in the contract.
- .5 NETWORK CABLING
 - .1 The GIGABIT ETHERNET standard shall be applied;
 - .2 Series TIA/EIA-568 Category 6 requirements shall be met (568A or 568B, to be determined);
 - .3 4 twisted pairs, minimum 24 AWG;
 - .4 Factory made for any length less of than 6 meters;
 - .5 Suitable length (avoid excessively-long cables);
 - .6 Cable meeting CSA FT6;
 - .7 Resistant to wet conditions when installed outdoors in buried conduits.
- .6 LOW VOLTAGE SUPPLY CABLE (24 volts and lower)
 - .1 Safety interlock, electromagnet and similar equipment shall be used
 - .2 1 pair copper multistrand AWG 16 cable (increase gauge based on voltage drop and usage);
 - .3 Resistant to wet conditions when installed outdoors in buried conduits.
 - .4 Cable meeting CSA FT4.
- .7 POWER SUPPLY CABLE (120 volts)
 - .1 For use in the power supply unit, controllers and similar equipment;
 - .2 1 pair minimum AWG 12 copper cable with green insulated grounding cable (increase gauge based on voltage drop and power consumption);
 - .3 To be installed in a conduit;
 - .4 Cable meeting CSA FT4.
 - .5 Resistant to wet conditions when installed outdoors in buried conduits.
- .8 SUPERVISION WIRING
 - .1 Scope of application: supervision posts and related equipment;
 - .2 2 pairs of minimum AWG 22 cable (increase gauge based on voltage drop and power consumption);

- .3 Cable meeting CSA FT4;
- .4 Resistant to wet conditions when installed outdoors in buried conduits.
- .9 COMMUNICATIONS WIRING
 - .1 Designed for RS-485 signals and similar devices;
 - .2 2 pairs twisted shielded minimum AWG 16 cable (increase gauge based on voltage drop and power consumption);
 - .3 Cable meeting CSA FT4;
 - .4 Resistant to wet conditions when installed outdoors in buried conduits.
- .10 NETWORK CONNECTOR
 - .1 Comply with Client's standard (568A or 568B, to be determined)
 - .2 Model appropriate for the selected network cable;
 - .3 Meet 1000BASE-T connection requirements.
- .11 WIRE-TO-WIRE CONNECTOR
 - .1 Compression type;
 - .2 With anti-corrosion and anti-humidity silicagel.
- .12 WIRE-TO-SCREW CONNECTOR
 - .1 Prong or ring type;
 - .2 Size appropriate for the screws and the gauge of the conductors.
- .13 FITTING OUT OF THE SECURITY EQUIPMENT ROOM
 - .1 Provide sleeves for joining the boxes together (no exposed wiring between equipment housings);
 - .2 Provide VELCRO fasteners to bundle cables together inside the equipment housings;
 - .3 Submit floor space requirement dimension drawings before starting work.

PART 3 - IMPLEMENTATION

- 3.1 Manufacturer's instructions
 - .1 Compliance: Comply with manufacturer's written requirements, recommendations and specifications, including available technical bulletins, instructions indicated in the product catalogue, instructions printed on product packaging and the information contained in data sheets.
- 3.2 Installation of the integrated security system
 - .1 WIRING
 - .1 Crimp cable using a tool designed for this purpose (no knives);
 - .2 Wiring shall be routed through hallways and follow the axes of the building (no diagonal shortcuts);
 - .3 All wiring shall be installed in conduits secured to the structure;
 - .4 Cables shall be bundled;
 - .5 Provide cable protectors when passing through housings or

electrical boxes;

- .6 Pull cable so as not to damage or degrade performance. In addition, cable shall be kept away from any sources that could impact signal quality.
- .7 Splicing of cable is prohibited.
- .8 Avoid antenna effects when cable is not connected at one end. Provide grounding in accordance with manufacturers' requirements.

.2 CONNECTOR (ALL TYPES)

- .1 Connect cable using a tool designed for this purpose (no pliers);

.3 FITTING OUT OF THE SATELLITE SECURITY EQUIPMENT ROOMS

- .1 Do not overlap 120-volt sources with low voltage;
- .2 Optimise available space and make provision for future expansion.

END OF SECTION

Part 1 General**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect communication raceway systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products**2.1 SYSTEM DESCRIPTION**

- .1 Empty telecommunications raceways system consists of outlet boxes, cover plates, terminal, distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.
- .2 Distribution system by conduits on ceiling.

2.2 MATERIAL

- .1 Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Junction boxes, cabinets type: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Outlet boxes, conduit boxes, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .4 Fish wire: polypropylene type.

- .5 Conduit diameter for telecommunication (data and telephone) shall not be smaller than the requirements of the following table:

Conduit size	Maximum quantity of cable
21 mm ($\frac{3}{4}$ ")	3
27 mm (1")	6
35 mm (1 $\frac{1}{4}$ ")	10
41 mm (1 $\frac{1}{2}$ ")	14
53 mm (2")	20
63 mm (2 $\frac{1}{2}$ ")	30
78 mm (3")	40

- .6 The diameter of the security conduits will be as indicated on plans or by the security consultant.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Coordinate the installation of empty raceways system with Departmental Representative of shared services Canada (SSC).
- .2 Install empty raceway system, including overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.
- .3 All conduit will be routed to connection cabinet on the services corridor.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

PART 1 - GENERAL

- 1.1 **Related Sections**
1. Section 01 74 19 - Construction/Demolition Waste Management And Removal.
 2. Section 27 05 14A - Telecommunications - Indoor Wiring.
 3. Section 26 05 34 - Conduits, Fittings and Connectors as regards conduits.
- 1.2 **Reference Documents**
1. Correctional Service of Canada – Department of Technical Services – Electronic Systems
 - .1 SE/ET-0101 Electronic Engineering Statement of Work – Purchase and Installation of Electronic Security Systems.
 - .2 SE/ET-0102 Electronic Engineering Statement of Work – Quality Control of Electronic Security System Purchase and Installation Actions.
 - .3 SE/STE-0101, Electronics Technical Specification - Public Address System for Use in Federal Correctional Facilities.
 2. Electronic Industries Association (EIA)
 - .1 EIA-310-C Electronic Industry Association Standard for Racks, Panels and Associated Equipment.
- 1.3 **Reference Standards**
1. Canadian Standards Association (CSA)/CSA International.
 2. EIA-310-D Electronic Industry Association Standard for Racks, Panels, and Associated Equipment.
 3. Underwriters' Laboratories (UL)
 - .1 UL 294-2009, Access Control System Units.
 - .2 UL 1076-2005, Safety for Proprietary Burglar Alarm Units and Systems.
 4. Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S316-14 Standard for Performance of Video Surveillance Systems.
- 1.4 **Definitions**
1. CSA: Canadian Standards Association.
 2. EST: Technical specifications
 3. GFE: Government-furnished equipment.
 4. CSC: Correctional Service of Canada
 5. CCCP: Central Control and Communications Post.
 6. UCP: Unit Control Post.
 7. UL: Underwriters Laboratories Inc.
 8. ULC: Underwriters Laboratories of Canada.
 9. EIA: Electronic Industries Association.

1.5 Performance Requirements

1. Field service (labour and parts) shall not be reserved for the exclusive use of the Contractor receiving the contract award. Devices shall be commercially available in the Joliette region and in the periphery from other installers, and at a competitively comparable price.
2. Ancillary parts such as switches, timers, etc. shall be firmly secured using screws or rails. (Use of adhesive tape is prohibited).
3. The system shall be of modular design, that is, it shall be composed of mechanically independent basic units (cabinet, frame, board, printed circuits, connectors, supply units, attachment terminals, etc.). Each basic unit shall be easy to install or to disassemble. Connections between units shall be made using cables terminating with connectors.
4. System operation, servicing, maintenance and testing shall be simple; the system shall also be easily expandable.
5. Any damage caused by a flawed device in a system shall be limited to the device itself and shall not impact other system devices. Contractor shall design the public address system architecture so as to insure operational continuity.
6. In order to render the equipment impervious to electromagnetic field effects, all major metallic parts (housings, cabinets and consoles) shall be grounded to the building's grounding grid. Grounding shall be provided in accordance with the manufacturer's recommendations. Cable shielding shall be grounded but only at one point on each of the sections unless otherwise specified in manufacturer's requirements.
7. The Contractor shall take all the necessary precautions to ensure the smooth operation of system devices within the tolerances set out below or in accordance with the tolerances specified by the manufacturer if such tolerances are more demanding. System devices shall be designed so as to function within the following environmental ranges.
 - .1 Computing devices
 - .1 Temperature: 10° to 30° Celsius
 - .2 Humidity: 20 to 80%
 - .2 Devices installed indoors
 - .1 Temperature: 0° to 40° Celsius
 - .2 Humidity: 10 to 90%
8. The coding of hardware and wiring shall be provided in accordance with a standard to facilitate identification.
 - .1 The Contractor shall be responsible for supplying and installing such coding.
 - .2 The Contractor shall ensure that the different sub-assemblies,

hardware and system devices are properly identified.

- .3 All wiring, cable and connectors shall be labelled at both (2) ends and shall carry the same number in printed characters at both ends using a permanent marking method that is water, solvent, and oil-resistant.

- 9. The affixing of any stickers or labels citing the name of the Contractor, subcontractor or supplier shall be approved by the Ministry representative.

1.6 Documents/Samples to be Submitted

1. Documentation Specifications

- .1 All final supporting documentation supplied pertaining to the system shall be accompanied by a waiver of relevant copyrights.
- .2 Documentation shall comply with the requirements of Statement of Work SE/ET-0101.

2. Preliminary Design:

- .1 The reference preliminary design plan shall be prepared subsequent to the review and approval of the Preliminary Design Report (PDR) by the head of design or his or her representative. This plan will include specifications, drawings and the approved PDR.
- .2 Contractor shall prepare and submit two (2) copies of the PDR to the head of design and one (1) copy to the contracting authority at least ten (10) days prior to the PDR review meeting. The PDR shall include:
 - .1 Performance specifications, including the flow diagrams for the proposed system. The technical analysis and data on the performance of the equipment shall facilitate confirmation of the system's specifications;
 - .2 Preliminary equipment drawings, including control panels and hardware racks;
 - .3 The list of standard equipment, including the part number, model number, name of the manufacturer and the quantity of each item;
 - .4 The list of custom-built equipment, including the model and the quantity of each item;
 - .5 The flow diagrams for all custom-built equipment;
 - .6 The design drawings for all custom-built equipment;
 - .7 The proposed product insurance plan;
 - .8 The proposed maintenance plan;
 - .9 The proposed spare parts supply plan;
 - .10 The proposed training plan.

3. Preliminary design review:

- .1 Contractor shall be responsible for organising the meeting to review the contents of the PDR. Contractor shall provide the space for the meeting as well as all necessary facilities. The head of design shall identify any part of the PDR that does not comply with CSC

requirements.

4. Final Design:

- .1 The final reference design plan shall be prepared subsequent to the review and approval of the final design report (FDR) by the head of design. It will serve as the basis for the control of all changes made to the design and performance of the equipment. The FDR shall include:
 - .1 All the information included in the reference preliminary design plan;
 - .2 Models of the control panel, ergonomic considerations, etc. as needed;
 - .3 Drawings and operational descriptions for custom-built equipment, including interface specifications;
 - .4 Installation diagrams and instructions;
 - .5 Model and updated availability analysis based on the final design of the system and the selected hardware.
 - .2 The FDR shall be prepared in accordance with recommended industry standards. Two (2) copies of the FDR shall be submitted to the head of design at least ten (10) days prior to the FDR review meeting.
5. Final Design Review:
- .1 A meeting to examine the contents of the FDR shall be held. The Contractor shall provide the space for the meeting as well as all necessary facilities. All contractor personnel responsible for the engineering design of the system/hardware shall be available to attend the review.

1.7 General

- 1. The system shall be comprised of standard equipment to the extent possible. The use of hardware of new design shall be restricted to interfaces, consoles or common control panels or to unique devices that cannot be readily found on the market.
- 2. In particular, design shall aim at keeping the number of wires required between system components to a minimum.
- 3. The planning of the system shall utilise a space diversity approach where the loss of an interconnection route will not adversely affect the operation of the system overall.
- 4. The Engineering Services Division of the CSC has established technical specifications and standards applicable to equipment for special-purpose electronic security systems that must meet very precise and demanding operational performance criteria as set out in the Electronics Standards. The technical acceptability of such systems means that the equipment is compliant with the applicable CSC specifications and

standards.

5. The technical approval process includes an evaluation of the compliance of the system and its subsystems with CSC specifications in one of the CSC's facilities or an evaluation in a CSC institution where the efficiency of the proposed technologies will be verified when they are meant to be used in the restrictive conditions of the operating environment.
6. The CSC shall also conduct a detailed verification of compliance with the technical specifications applicable to the system of interest. The CSC may, if it deems necessary, require a supplier to organise a full on-site demonstration. For some specifications, the CSC will rely on the results of testing conducted by the manufacturer at an independent testing facility considered acceptable by the CSC.
7. The supplier will be required to submit all product modifications to the CSC for review. Certification of equipment is an on-going process and suppliers may request an evaluation at any time. The specifications and standards of the CSC shall be made available to any supplier making such a request. All enhancements and new products shall be submitted to the head of engineering, CSC Engineering Services Department, within a reasonable amount of time prior to any bidding process in order to allocate a sufficiently long evaluation period, which can last up to sixteen (16) months.
8. The contractor shall bear all liability for equipment orders placed before approval of the design of the door/barrier/bar control system. The head of design may authorise the purchase of some items requiring lengthy timeframes for delivery at the time of the preliminary design review of the proposed system or shortly thereafter.

1.8 System Description

1. The purpose of the public address system is to give institutional staff a means of making announcements in any given sector of the institution or throughout the entire facility. The public address system should mainly enable the institution's staff to call an inmate or a group of inmates and to make important announcements in the event of an emergency such as, in particular, fire or turmoil. The Contractor shall design, deliver, install and test a public address system for the perimeter intrusion detection system as well as provide training and produce the relevant documentation in accordance with requirements set out in the specification.
2. System Capacity:
 - .1 The control post(s) may be connected to the institution's telephone system or may be stand-alone. In any case, any number of sectors should be able to be selected from the control post by actuating the relevant commands. More than one subsector at a time should be able to be selected from the secondary control post(s); a GENERAL

ANNOUNCEMENT should be able to be made in all the subsectors of any given sector.

- .2 The system shall be of modular design allowing the future installation of additional control posts and loudspeakers without modifying the existing equipment.

3. System Configuration

- .1 The public address system shall be divided operationally into several sectors and subsectors representing the different designated areas of the institution. The sectors referred to, as well as the number of control posts and their location, shall be indicated in the EST. The quantity and location of the various items of equipment comprising the complete public address system shall also be included.

- .2 The system shall consist of the following components:

- .1 one or more main control posts, each post including a main control panel and a microphone or an institutional telephone;
- .2 one or more secondary control posts, each post including a secondary control panel and a microphone or an institutional telephone;
- .3 one or more loudspeaker units, each composed of a loudspeaker and a transformer, an enclosure and a noise barrier or baffle;
- .4 shared equipment (amplifiers, power supply units, switches and similar components);
- .5 interconnecting wires, cabling and similar components; and
- .6 conduits, ducts, receptacle boxes and similar components.

4. The system shall be of a constant voltage type; transformers shall have selectable outlets allowing the adjustment of the audio output power of each loudspeaker.

1.9 Replacement Equipment

1. Support Requirements

- .1 Maintenance and spare parts support for the door/barrier/bar control system shall be compliant with the requirements of Statement of Work document SE/ET-0101.

2. Maintenance and Spare Parts

- .1 The Contractor shall submit maintenance and spare parts provisioning support plans to the head of design for approval. These plans shall be submitted on the dates indicated in the schedule.

3. Maintenance Plan

- .1 The Maintenance Plan shall describe the method, procedures and frequency of preventative maintenance (PM), the methods and response times related to corrective maintenance (CM) and the average repair turnaround time (ARTT) for all systems. The plan shall specify the tools, sizes and shapes and testing materials, and

describe the method for assigning the recommended staff for the system. The final maintenance support plan shall be issued subject to approval by the head of design.

4. Provisioning plan for spare parts
 - .1 The provisioning plan for spare parts shall include the list of required spare parts and the recommended quantity of each item. Recommendations on quantities shall be based on the availability and reliability analysis of the system and on available technical results. The contractor shall identify spare parts and components using the manufacturer's product number cross-referenced to the part number used by the equipment's supplier.
5. List of spare parts
 - .1 The list of spare parts shall include the following information:
 - .1 Spare parts and sub-assemblies as well as recommended quantities;
 - .2 List of cross-references between suppliers' codes and manufacturers' codes;
 - .3 The unit price and the calculated price for warehousing;
 - .4 The expected useful life or annual consumption of each part.
 - .2 The contractor shall keep the spare parts provisioning plan up-to-date until the end of the warranty period and shall ensure that any modification triggered by design changes is included in the list of spare parts.

1.10 Warranty

1. Warranty provided for under the contract: The following terms will be added to the General Terms & Conditions. In the event of conflict between these two sets of conditions, the more stringent conditions shall apply.
2. The warranty shall cover all equipment and shall include the costs of labour as well as the equipment and supplies needed for the following services:
 - .1 Preventative maintenance.
 - .2 Replacement and repair of defective parts.
 - .3 Technical support for any additions.
 - .4 Travel to the site.
3. During the warranty period, should one or more devices associated with the different systems break down, service personnel shall be reachable 24 hours a day/7 days a week. Said service personnel shall travel to the site and locate the source of the problem within 4 hours of receiving the service request; they shall then repair the problem as soon as practicable in order to disturb as little as possible the operations of the Ministry's representative and the facility's level of security.
4. The Contractor shall keep the necessary quantity of spare parts in inventory to comply with the specified requirements.

5. If a manufacturer offers a warranty on an equipment item for a period of time longer than that specified in the General Terms and Conditions, Contractor shall transfer such warranty to the system's end-user.
6. The warranty shall not be less than one year from the date of acceptance of the work.

PART 2 - PRODUCTS

2.1 Supplies/ Equipment

1. System hardware shall meet the requirements of the electronics technical specification document – SE/STE-0101, Public Address System for Use in Federal Correctional Facilities SE/STE-0101 Revision 2 (8 March 2002).
2. Conduits: compliance with Section 26 05 34 - Conduits, fixtures and connections.
3. Conductors for communications systems: in accordance with the manufacturer's instructions, compliant with Section 27 05 14A – Wire and Cable for Security Systems.

2.2 Operating Cycle

1. The system as well as all the associated equipment shall be expected to function 24 hours a day, 7 days a week, and shall be certified for this purpose.

2.3 Components

1. LOUDSPEAKER ARRAY
 - .1 Loudspeaker arrays shall include the following components: a loudspeaker and a power transformer, an enclosure and a baffle.
 - .2 Different types of arrays may be required: indoor loudspeakers to be mounted on the ceiling/wall, and loudspeakers for large indoor spaces.
 - .3 All arrays shall have high resistance to attempts at tampering or destruction. Contractor shall submit a specimen of each model to the head of design for approval prior to the procurement process.
 - .4 The loudspeakers must be within the SD72WV series as per existing.
2. LOUDSPEAKERS
 - .1 Loudspeakers shall have the requisite power and be compatible with the housing into which they are mounted.
3. HOUSINGS
 - .1 Loudspeaker housings shall be sturdy and tamper-resistant. In addition, they shall be free of mechanical resonances that may degrade system performance or sound quality.
 - .2 The Contractor shall provide the protection needed for loudspeakers installed in locations where they can be damaged by the inmates.

4. BAFFLES

- .1 The baffle used together with the speaker housing shall be of thick steel plate and secured to the housing by means of tamper-proof screws. The baffle shall be designed to provide good sound dispersion in the area of interest and shall protect the speaker against the introduction of foreign bodies such as pencils, piano wire and the like.

5. TRANSFORMERS

- .1 The transformer included with the loudspeaker array shall have several selectable outlets allowing on-site adjustment of the power level required for each loudspeaker.

6. ENVIRONMENTAL SPECIFICATIONS

- .1 The system shall be installed in accordance with the requirements of Statement of Work document SE/STE-0101, Public Address System for Use in Federal Correctional Facilities, Revision 2 (8 March 2002).

7. POWER SUPPLY SPECIFICATIONS

- .1 The system shall be installed in accordance with the requirements of Statement of Work document SE/STE-0101, Public Address System for Use in Federal Correctional Facilities, Revision 2 (8 March 2002).

PART 3 - IMPLEMENTATION

3.1 Manufacturer's instructions

- 1. Compliance: adhere to manufacturer's written requirements, recommendations and specifications, including available technical bulletins, and instructions included in the product catalogue, instructions printed on product packaging and the information contained in the product data sheets.

3.2 Work Summary

- 1. The existing public address system is designed based on an architecture for Innovative Electronic Design products.
- 2. The Contractor shall provide for the supply, installation, adjustment, activation and testing of all the loudspeakers specified in the plans. The local public address system affected by the work consists of four (4) loudspeakers located in the kitchen sector and in the shipping/receiving area.
- 3. The loudspeakers in the kitchen sector connect to a loudspeaker located in the technical bridge. The loudspeaker located in the shipping/receiving area connects to the loudspeaker located in the warehouse section.
- 4. At the beginning of the work, the contractor must provide for the removal

of the four (4) loudspeakers and the cables up to the first loudspeaker located outside the work area. The contractor must ensure the temporary removal of the loudspeaker cables will not affect the system performance of the other loudspeakers in the same zone.

5. Immediately following the demolition work, the contractor must provide for the replacement of the four (4) loudspeakers and the addition of four (4) new loudspeaker at the locations indicated in the plan. The four (4) new loudspeaker must be connected to the loudspeaker located in the warehouse section.
6. The contractor must ensure that system configuration is not modified. The loudspeaker programming remains the same. The contractor must ensure the coordination with the client for the replacement and addition of the new loudspeaker.
7. The contractor must provide for the replacement and addition of the set of loudspeakers in accordance with the technical specifications described in the technical specifications and the document: SE/STE-0101, Public Address System for Use in Federal Correctional Facilities.

3.3 Installation

1. Install the equipment in accordance with manufacturer's recommendations and instructions.
2. Installation Specifications
 - .1 The system shall be installed in accordance with the requirements of Statements of Work SE/ET-0101 and SE/ET-0102.
 - .2 The system shall meet the requirements of the electronics technical specification document – Public Address System for Use in Federal Correctional Facilities SE/STE-0101 Revision 2 (8 March 2002).
3. Documentation Specifications
 - .1 All system-related final documentation shall include a waiver of copyrights. Documentation shall comply with the requirements of Statement of Work SE/ET-0101.
4. Support Specifications
 - .1 Maintenance and spare parts support for the system shall be compliant with the requirements of Statement of Work document SE/ET-0101.
5. Training Specifications
 - .1 Operator training and system maintenance training shall comply with the requirements set out in Statement of Work SE/ET-0101.

3.4 On-site Quality Control

1. The quality assurance programme for the door/barrier/bar control system shall be compliant with the requirements of Statement of Work document SE/ET-0101.

2. All installation work, as well as test plans and acceptance testing plans, shall be compliant with the requirements of Statement of Work SE/ET-0101.
3. System Test Plan.
 - .1 The plan shall specify the testing method used, the tests to be conducted, pass/fail criteria, retesting requirements and instructions for validating and approving all the specifications in the final reference design plan. Prior to witnessing the tests, the CSC representative shall conduct a visual mechanical inspection to ascertain whether system installation has been completed.
4. Testing procedures. These procedures shall be drawn up so that:
 - .1 All the supplied equipment complies with performance specifications;
 - .2 Each subsystem meets performance requirements;
 - .3 The entire system meets performance requirements;
 - .4 Testing procedures include the steps to be followed for each test and the expected outcome.
5. All the necessary steps are taken so that the Ministry representative assigned to the project can review the work related to maintenance, installation, application, protection and site clean-up. The Ministry representative will submit written reports that will confirm whether the work was performed in accordance with contractual requirements.
6. Services of the Ministry representative: summon the Ministry representative, who will make on-the-spot recommendations as to the use of the product(s) and will conduct periodic inspections to check whether implementation has occurred in accordance with his/her recommendations.
7. Make provision for site inspections at the following stages:
 - .1 Once the products are delivered and stored on the site and site preparation and other preliminary work is complete but before commencing the installation work referred to in this section.
 - .2 Twice, as work is in progress; that is, when work is 33% complete and when it is 60% complete.
 - .3 Once all work is complete and site clean-up has been performed.
8. The Ministry representative shall furnish the inspection reports within five days of site inspection.

3.5 Inspection

1. Carry out inspection and testing in the presence of the Ministry representative.
 - .1 Provide all tools, ladders and the necessary equipment.
 - .2 Ensure that all subcontractors and Ministry representatives are present when inspections are conducted.

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2. Testing shall be conducted in compliance with the approved plan and procedures.
 3. Contractor shall notify the CSC at least 5 business days before commencing testing.
 4. Visual inspection: an inspection having the purpose of evaluating the quality of installation and assembly as well as the overall appearance of the equipment so as to ascertain whether the system is compliant with the contract documents. Such inspection shall cover:
 - .1 The durability of the equipment fittings and fasteners.
 - .2 Any damage potentially caused by installation work.
 - .3 Compliance of device locations with the revised shop drawings.
 - .4 Compatibility of equipment installation with the physical environment.
 - .5 Supply of all accessories.
 - .6 Identification of devices and cable colour-coding.
 - .7 Decals posted at the appropriate locations indicating ULC approval.
 5. Technical Inspection: an inspection having the purpose of ascertaining that all systems and mechanisms have been correctly installed and are free of defects; this inspection shall cover the following:
 - .1 Voltage and power measurement.
 - .2 Junctions/connections and securing equipment in place.
 - .3 Measurement of signals and parameters, i.e. noise (dB), illuminance (lux) and transmission rate (baud).
 - .4 Compliance with specifications, documentation and manufacturer's installation instructions.
 6. Operational inspection: an inspection aimed at ensuring that device and system performance is compliant with or exceeds the specified functional requirements and may cover the following:
 - .1 The correct working order of each device, individually and in its environment.
 - .2 The correct working order of each device in association with an operating schedule and/or specific functions.
 - .3 Demonstration of the following functions:
 - .1 Interoperability with other security systems.
 7. The Contractor shall submit the final copies of the testing results for review and approval by the CSC within ten (10) business days of completion of testing. Two (2) copies of the testing report shall be provided and will include:
 - .1 A summary description of testing;
 - .2 Testing results, including the procedures used in testing which shall have been checked by a CSC representative;
 - .3 Trouble reports, including an analysis of the incidents and the remedial measures taken;
 - .4 The results of any tests that had to be repeated.

3.6 Clean-up and
adjustments

1. Remove any protective coverings on loudspeakers and other components.
2. Adjust the loudspeakers.
3. In accordance with the manufacturer's instructions, clean the loudspeaker boxes and other system components to remove packing materials, fingerprints and other marks.

END OF SECTION

PART 1 - GENERAL

- 1.1 Related sections
- .1 Section 01 74 19 – Management and elimination of construction/demolition waste.
 - .2 Section 27 05 14A – Wiring and cables – For security systems.
 - .3 Section 26 05 34 - Conduits, fixtures and conduit connections, for conduits.
- 1.2 Reference documents
- .1 Correctional Service Canada – Technical Services Branch – Electronic Systems
 - .1 SE/AND-0101 Statement of Electronic Engineering Work – Procurement and Installation of Electronic Security Systems.
 - .2 SE/AND-0102 Statement of Electronic Engineering Work – Quality control of supply and installation operations for electronic security systems.
- 1.3 Reference standards
- .1 Canadian Standards Association (CSA)/CSA International
 - .2 EIA-310-D Electronic Industry Association Standard for Racks, Panels and Associated Equipment
 - .3 Underwriters' Laboratories (UL)
 - .1 UL 294-2009, Access Control System Units.
 - .2 UL 1076-2005, Safety for Proprietary Burglar Alarm Units and Systems.
 - .4 Underwriters Laboratories Canada (ULC)
 - .1 CAN/ULC-S316-14 Standard for Performance of Video Surveillance Systems.
- 1.4 Definitions
- .1 UPS Uninterrupted Power Supply
 - .2 CSA Canadian Standards Association
 - .3 EIA Electronic Industries Association
 - .4 CCCS Central command and communication station
 - .5 UCS Unit Control Station
 - .6 CBCS Cell-based Call System
 - .7 CSC Correctional Service Canada
 - .8 DCS Door/barrier/grille Control System
 - .9 CER Common equipment room
 - .10 FAIS Facility Alarm Indication System
- 1.5 Performance requirements
- .1 After-sales service (labour and parts) must not be for the exclusive use of the Contractor awarded the contract. Devices must be commercially available in the Montreal area and environs from other installers, at prices comparable to the competition.
 - .2 Secondary parts such as relays, timers, etc. must be solidly secured

with screws or a rail. (Use of adhesive strips is prohibited).

- .3 The system must be modular in design, consisting of independent basic mechanical units (cabinet, chassis, cards, printed circuits, connectors, power supplies, connection terminals, etc.). Each base unit must be easy to install or disassemble. Connections between units will be made by cables with connector terminals.
 - .4 System operation, maintenance and testing must be simple; the system must also be easily expandable.
 - .5 Damage caused by a defective device in a system must be limited to that device and must not affect other devices in the system.
 - .6 To shield them fully from electromagnetic fields, all major metal parts (base frames, cabinets and desks) must be grounded to the buildings grounding grid. Grounds must be made in compliance with manufacturer's recommendations. All cable shielding must be grounded, but in a single point for each section unless otherwise indicated in the manufacturer's requirements.
 - .7 The Contractor must take all necessary precautions to ensure proper operation of system devices within variances defined below, or consistent with variances defined by the manufacturer where these variances are more demanding. System devices must be designed to operate within the following environmental parameters:
 - .1 Devices installed indoors
 - .1 Temperature: 0° to 40° Celsius
 - .2 Humidity: 10 to 90 %
 - .8 Coding of equipment and cables is planned to a standard to facilitate tracing.
 - .1 The Contractor is responsible for supply and installation of this coding.
 - .2 The Contractor must ensure that the various system subassemblies, equipment and devices are properly identified.
 - .3 All wiring, cables and connectors must be identified at both (2) ends and bear the same number in printed characters at each end, using a permanent marking technique resistant to water, solvent and oil.
 - .9 Installation of stickers or labels indicating the name of the Contractor, a subcontractor or supplier must be approved by the Department's representative.
- 1.6 Documents/
samples to be
submitted
- .1 Documentation specifications
 - .1 All final support documentation supplied for the door/barrier/grille control system must be accompanied by a waiver of related copyright.
 - .2 Documentation must comply with the requirements of the statement

of work document SE/AND-0101.

- .2 Preliminary design:
 - .1 The reference preliminary design plan was developed following review and approval of the preliminary design report (PDR) by the head of design or his representative. This plan must include the specifications, drawings and approved PDR.
 - .2 The Contractor must prepare and submit two (2) copies of the PDR to the head of design and one (1) copy to the contract officer at least ten (10) days before the PDR review meeting. The PDR must include:
 - .1 The specifications on performance consisting of operating diagrams for the proposed system. The equipment technical analysis and performance data must support confirmation of system specifications;
 - .2 The preliminary equipment plans, including control consoles and equipment bays;
 - .3 The list of standard equipment, including the part number, model, manufacturer's name and quantity for each item;
 - .4 The customized equipment list, including the model and quantity for each item;
 - .5 The operating diagrams for all customized equipment;
 - .6 The conceptual drawings for all customized equipment;
 - .7 The proposed plan for product insurance;
 - .8 The proposed plan for maintenance;
 - .9 The proposed plan for supply of replacement parts;
 - .10 The proposed plan for training.
- .3 Review of preliminary design:
 - .1 The Contractor must take responsibility for organizing the PDR content review meeting. It must provide the premises for the meeting as well as all necessary facilities. The head of design will indicate any part of the PDR that does not meet CSC requirements.
- .4 Final design:
 - .1 The reference final design plan will be produced following the review and approval of the final design report (FDR) by the head of design. This serves as the basis for control of changes made to the equipment design and performance. The FDR must include:
 - .1 All components included in the reference preliminary design plan;
 - .2 Models of the command console, ergonomic considerations, etc. as required;
 - .3 Operational drawings and descriptions for customized equipment, including interface specifications;
 - .4 Installation drawings and instructions;
 - .5 The updated model and availability analysis based on the final design for the system and the equipment selected.

.2 The FDR must be prepared in compliance with recommended commercial practices. Two (2) copies of the FDR must be submitted to the head of design at least ten (10) days before the FDR review meeting.

.5 Final design review:

.1 A meeting to review the FDR content must be held. The Contractor must provide the premises for the meeting as well as all necessary facilities. All of the Contractor's staff responsible for technical design of the system/equipment must be available.

1.7 General

.1 The system must consist of standard equipment to the fullest extent possible. Use of new-design equipment must be limited to common interfaces, consoles or control panels or to single devices that cannot be obtained off the shelf.

.2 The design specifically must strive to minimize the number of wires required between all system components.

.3 Planning of the system must use a space diversity approach such that loss of one interconnection pathway does not adversely affect operation of the system as a whole.

.4 CSC's Engineering Services Division has established technical specifications and standards that apply to equipment for specific electronic security systems, and these must meet very specific and demanding criteria for operational performance, described in the Electronic Standards. Technical acceptability of these systems means that equipment complies with application CSC specifications and standards.

.5 The technical approval process includes an assessment of the system and subsystems in compliance with CSC specifications in one of CSC's institutions, or an assessment in a CSC institution where the effectiveness of the proposed technologies is verified when these must be applied under restrictive operating environment conditions.

.6 CSC must also verify in detail compliance with technical specifications applicable to the system in question. If it deems necessary, CSC may require the supplier to organize a full demonstration on site. For certain specifications, CSC will rely on the results of tests conducted by the manufacturer in an independent testing facility deemed acceptable by CSC.

.7 It is incumbent on the supplier to submit for CSC's assessment any change made to the products. Equipment certification is an ongoing process and a supplier may request an assessment at any time. CSC specifications and standards are available to any supplier on request. Any improvement or any new product must be submitted to the technical

head of CSC's Engineering Services Division within a reasonable time before any call for tenders process to allow sufficient time for assessment, which can take up to sixteen (16) months.

- .8 Any order of equipment placed before approval of the design report for the door/barrier/grille control system will be at the Contractor's risk. The head of design may authorize the purchase of certain items subject to long delivery delays at the time of the preliminary design study for the proposed system or shortly thereafter.

1.8 Replacement equipment

- .1 Support specifications
 - .1 Maintenance support and replacement part plans for the door/barrier/grille control system must comply with the requirements of statement of work document SE/AND-0101.
- .2 Maintenance and replacement parts
 - .1 The Contractor must supply maintenance support and replacement part supply plans for approval by the head of design. These plans must be submitted by the dates indicated on the calendar.
- .3 Maintenance plan
 - .1 The maintenance plan must describe the preventive maintenance (PM) approach, procedures and calendar, methods and response times for corrective maintenance corrective as well as the average repair time (MTTR) for all systems. The plan must recommend the tools, templates and test equipment, and must describe in detail the staff assignment method recommended for the system. The final maintenance support plan will be issued subject to approval by the head of design.
- .4 Replacement parts supply plan
 - .1 The replacement parts supply plan must include the list of replacement parts required and the recommended quantity for each. Recommendations on quantity must be supported by analysis of availability and system reliability and by available technical results. The Contractor must identify the replacement parts and components by their manufacturer's code number and with references to the part numbers used by the equipment supplier.
- .5 List of replacement parts
 - .1 The list of replacement parts must include the following information:
 - .1 Replacement parts and subassemblies as well as recommended quantities;
 - .2 A list of references between supplier codes and manufacturer's code numbers;
 - .3 Unit prices and prices calculated for warehousing;
 - .4 Forecast service life or annual consumption for each part.
 - .2 The Contractor maintain an up-to-date replacement parts supply

plan up to the end of the warranty period and must ensure that any change resulting from design modifications is incorporated into the list of replacement parts.

1.9 Warranty

- .1 Warranty provided in the contract: The following conditions are added to the general conditions. In the event of a contradiction between the two conditions, the more demanding conditions shall apply.
- .2 The warranty is applicable to all equipment devices and must include the cost of labour, equipment and materials for the following services:
 - .1 Preventive maintenance.
 - .2 Replacement and repair of defective parts.
 - .3 Technical support for any possible additions.
 - .4 Travel to the site.
- .3 During the warranty period, in the event of breakdown of one or more devices in the various systems, it must be possible to reach service staff at all times, 24 hours a day, 7 days a week. These service staff must travel to the site and locate the breakdown within four hours following the service call, and repair the breakdown as quickly as possible, to disrupt operations and facility security levels as little as possible.
- .4 The Contractor must maintain in its inventory the necessary quantity of replacement parts to comply with the requirements indicated.
- .5 Where a manufacturer provides a warranty greater than that requested in the general conditions for a piece of equipment, the Contractor must transfer that warranty to the system user.
- .6 The warranty may not be for less than one year from date of final acceptance of the work.

PART 2 - PRODUCTS

2.1 Materials/ equipment

- .1 System materials must meet the requirements in the reference document listed in section 1.2 "Reference documents" and in section 1.3 "Reference Standards."
- .2 Conduits: compliant with section 26 05 34 - Conduits, fixtures and conduit connections.
- .3 Wiring and cable: based on manufacturer's indications, compliant with section 27 05 14A – Wiring and cable – For security systems.

2.2 System configuration

- .1 (ENMC) ELECTRIC DOOR MAGNETIC CONTACT
 - .1 Door magnetic contacts will be supplied by another division.
 - .2 The model supplied will be an SPDT type model such as models 201020 or 201023 from the manufacturer R.R. Brink Locking

Systems Inc.

- .2 (SEM) SINGLE ELETROMAGNET
 - .1 Electromagnets will be supplied by another division.
 - .2 Electromagnets will be equipped with a contact to indicate locking status and status of magnetic retention, and must be connected to the door supervision system.
 - .3 Operation on low voltage 12 VDC.
- .3 (KS) KEY SWITCH
 - .1 Sustained or intermittent key switch based on use of dual pole dual terminal (DPDT) for transmission of a request for bypass of supervision and locking of a door;
 - .2 2 keys per cylinder;
 - .3 Aluminum finish plate;
 - .4 The cylinder must be prepared from a controlled key path and architecture, to be determined;
 - .5 Tamper-proof screw for the key switch plate;
 - .6 The key switch must be of series CM-1200 from Camden Control or the equivalent.
- .4 (DCS) DOOR/GATE/GRATING CONTROL SYSTEM
 - .1 Equipped with primary protection.
 - .2 Equipped with individual secondary protection for each connected device.
 - .3 Minimum of 4 hour self-operation mode in case of power failure under the most stringent operating conditions.
 - .4 Cabinet fitted with lockset and 2 keys.
 - .5 Cabinet fitted with a permanent identification plate.
 - .6 Equipment in the cabinet must be layed out so as to minimize the visible wiring using troughs for their passage.
 - .7 All wiring entering the cabinet must be terminated before being distributed.
- .5 (EL) ELECTRIC LOCK
 - .1 The electric locs will be supplied by another division.
 - .2 The electric lock will ne equipped with a contact to indicate locking status and engagement of the bolt, and must be connected to the door supervision system.
 - .3 The electric lock will be the "fail safe" type, which means that the lock must be powered to be locked.
 - .4 Operation on low voltage 12 VDC.
- .6 (UPS) UNINTERRUPTED POWER SUPPLY
 - .1 Provide an uninterruptible power supply to produce a stable electric power supply and devoid of cut-off when a power failure occurs and with enough sockets for all the equipment.
 - .2 The contractor shall provide UPS in accordance with the technical criteria specified in the ES/NE-0804 revision 3 standard.

PART 3 - EXECUTION

- 3.1 Summary of the work
- .1 Project CSC Archambault Institution, Refinishing Kitchen – Building U.
 - .1 The access control system is designed to prevent the simultaneous opening of more than one door in the interlock system.
 - .2 The access control system must be powered by an electric circuit connected to the emergency panel (generator).
 - .3 Power to the access control system must also be connected to an uninterruptible power supply (UPS) unit.
- 3.2 Manufacturer's instructions
- .1 Compliance: comply with written manufacturer's requirements, recommendations and specifications, including any available technical bulletin, instructions appearing in the product catalogue, those appearing on product packaging and indications on technical fact sheets.
- 3.3 Installation
- .1 (ENMC) DOOR MAGNETIC CONTACT
 - .1 The built-in magnetic contact is included in another call for tenders (supply and installation outside security lot contract);
 - .2 The Contractor must remove the device and reinstall it after making the connection;
 - .3 The device must be connected to the DCS controllers.
 - .2 (SEM) SINGLE ELECTROMAGNET
 - .1 The electromagnets will be supplied by another division.
 - .2 The Contractor must remove the device and reinstall it after making the connection.
 - .3 The locking supervision and retention supervision must be connected to the DCS controllers.
 - .4 The device must be powered from a power supply dedicated to access control devices.
 - .3 (KS) KEY SWITCH
 - .1 The device must be surface installed;
 - .2 The connection must be concealed in the wall in an electrical box;
 - .3 The key switch contact must be connected to the DCS controllers.
 - .4 Dedicated to access control components.
 - .4 (DCS) DOOR/GATE/GRATING CONTROL SYSTEM
 - .1 The wiring must be disposed onto cable trays;
 - .2 Wire color coding shall be identical from one device to another and from one controller to another;
 - .3 In each controller, provide a description sheet for all inputs and outputs;

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- .4 Individual cabinet identification;
 - .5 Permanent connection to the AC circuit (no electric plug);
 - .6 Upon short-circuit of a faulty device to the controller, it shall not affect other devices or the controller itself; supply and install secondary protection if necessary;
 - .7 Power failure supervision monitored by the access control system;
 - .8 Indicate on the batteries the date of the first update support of the UPS.
- .5 (HSEL) HIGH SECURITY ELECTRIC LOCK
- .1 High security electric locks will be supplied by another division.
 - .2 The Contractor must remove the device and reinstall it after making the connection.
 - .3 Locking supervision and bolt projection supervision must be connected to the DCS controllers.
 - .4 The device must be powered from a power supply dedicated to access control devices.
- .6 (UPS) UNINTERRUPTED POWER SUPPLY
- .1 The Contractor must install the UPS device inside the metal cabinet (Middle Atlantic Product Inc.).
 - .2 The Contractor must install the UPS device in accordance with the specifications outlined in the norm ES/NE-0804 révision 3;
- .7 Install the equipment as indicated and in compliance with the manufacturer's instructions.
- .8 Installation specifications
- .1 The system must be installed in compliance with the requirements of statement of work documents SE/AND-0101 and SE/AND-0102.
 - .2 The system must meet the requirements of the electronic technical specification document— Audio System for use in federal correctional institutions SE/STE-0101 version 2 (8 March 2002).
- .9 Documentation specifications
- .1 All final documentation related to the system must be accompanied by a waiver of copyright. The documentation must comply with requirements of statement of work document SE/AND-0101.
- .10 Support specifications
- .1 System maintenance and replacement parts must be provided in compliance with the requirements of statement of work document SE/AND-0101.
- .11 Training specifications
- .1 Operator training and system maintenance training must comply with the requirements contained in statement of work document SE/AND-0101.

3.4 On-site quality control

- .1 The door/barrier/grille control system quality assurance program must comply with requirements of statement of work document SE/AND-0101.
- .2 All installation, as well as all test plans and acceptance tests must be performed in compliance with the requirements of statement of work document SE/AND-0101.
- .3 System test plan.
 - .1 The plan must contain the method used for testing, the tests to be conducted, the criteria for pass/fail, the requirements for repetition of tests and the validation and approval instructions for all final reference design plan specifications. Before attending tests, the CSC representative will conduct a visual inspection and a mechanical inspection to ensure that system installation has been performed in compliance with the requirements.
- .4 Testing procedures. These procedures must be developed such that:
 - .1 All equipment supplied meets with the performance specifications;
 - .2 Each subsystem meets the applicable performance requirements;
 - .3 The system as a whole meets the performance requirements;
 - .4 The testing procedures contain steps to follow for each test and the anticipated results.
- .5 Make the necessary arrangements for the Department's representative assigned to the project to inspect the work related to handling, installation, application, protection and cleaning of the equipment. The Department's representative will submit written reports to validate whether work has been performed in compliance with contractual requirements.
- .6 Services of the Department's representative: convene the Department's representative to make recommendations on site regarding use of the product(s) and conduct periodic inspections to determine whether commissioning has been performed in compliance with his recommendations.
- .7 Plan site inspections at the following stages:
 - .1 Once products have been delivered and stored on the site, and preparatory and other preliminary work has been completed, but prior to start of equipment installation work covered by this section.
 - .2 Twice during the progress of work, when it has reached 33 and 60 percent respectively.
 - .3 Once work and cleaning have been completed.
- .8 The Department's representative will submit inspection reports within five days of the site inspection.

3.5 Control

- .1 Conduct inspections and testing with the Department's representative

present.

- .1 Supply the necessary tools, ladders and equipment.
 - .2 Ensure that subcontractors and departmental representatives are present at the time of the inspections.
- .2 Tests must be conducted in compliance with the approved plan and procedures.
 - .3 The Contractor must notify CSC at least five (5) working days prior to the start of testing.
 - .4 Visual inspection: inspection to assess quality of installation and assembly as well as overall appearance of the equipment, to ensure that the system complies with the contract documents, and must focus on the following points:
 - .1 Sturdiness of equipment mounting.
 - .2 Lack of damage due to installation.
 - .3 Compliance of device locations with revised shop drawings.
 - .4 Compatibility of equipment installation with the physical environment.
 - .5 Supply of all accessories.
 - .6 Identification of devices and coding of cabling.
 - .7 Correct placement of decals indicating ULC approval.
 - .5 Technical inspection: inspection to verify that all systems and devices have been correctly installed, are free of defects and damage, and must focus on the following points:
 - .1 Measurement of voltage and amperage.
 - .2 Junctions/connections and equipment mounting.
 - .3 Measurement of signals and parameters, e.g. noise (dB), lighting (lux), transmission speed (baud).
 - .4 Compliance with manufacturer's installation specifications, documentation and instructions.
 - .6 Operational inspection: inspection to ensure that performance of devices and systems complies with or exceeds established operating requirements, and must focus on the following points:
 - .1 Operation of each device, individually and in its environment.
 - .2 Operation of each device in association with a programmable calendar and/or with specific functions.
 - .3 Demonstration of the following functions:
 - .1 Interoperability with other security systems.
 - .7 The Contractor must submit the final copies of test results for review and approval by CSC within ten (10) working days of the end of testing. It must provide two (2) copies of test reports, which must include:
 - .1 A summary description of the tests;
 - .2 Test results, including the test procedures conducted, which were checked by a CSC representative;

- .3 Incident reports, including analysis of incidents and the corrective measures taken;
- .4 Results of any tests that had to be repeated.

END OF SECTION

ART 1 - GENERAL

- 1.1 Related sections
- .1 Section 01 74 19 – Management and elimination of construction/demolition waste.
 - .2 Section 27 05 14A – Wiring and cables – For security systems.
 - .3 Section 26 05 34 - Conduits, fixtures and conduit connections, for conduits.
- 1.2 Reference documents
- .1 Correctional Service Canada – Technical Services Branch – Electronic Systems
 - .1 SE/AND-0101 Statement of Electronic Engineering Work – Procurement and Installation of Electronic Security Systems.
 - .2 SE/AND-0102 Statement of Electronic Engineering Work – Quality control of supply and installation operations for electronic security systems.
 - .3 ES/SPEC-0600 Electronics Engineering Specification – Personal Portable Alarm system for Federal Correctional Institutions.
- 1.3 Reference standards
- .1 Canadian Standards Association (CSA)/CSA International
 - .2 EIA-310-D Electronic Industry Association Standard for Racks, Panels and Associated Equipment
 - .3 Underwriters' Laboratories (UL)
 - .1 UL 1076-2005, Safety for Proprietary Burglar Alarm Units and Systems.
- 1.4 Definitions
- .1 UPS Uninterrupted Power Supply
 - .2 CSA Canadian Standards Association
 - .3 EIA Electronic Industries Association
 - .4 CCCS Central command and communication station
 - .5 UCS Unit Control Station
 - .6 CSC Correctional Service Canada
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 - .8 FAIS Facility Alarm Indication System
 - .9 PPA Personal Portable Alarm
- 1.5 Performance requirements
- .1 After-sales service (labour and parts) must not be for the exclusive use of the Contractor awarded the contract. Devices must be commercially available in the Montreal area and environs from other installers, at prices comparable to the competition.
 - .2 Secondary parts such as relays, timers, etc. must be solidly secured with screws or a rail. (Use of adhesive strips is prohibited).
 - .3 The system must be modular in design, consisting of independent basic mechanical units (cabinet, chassis, cards, printed circuits, connectors, power supplies, connection terminals, etc.). Each base unit must be easy to install or disassemble. Connections between units will be made by cables with connector terminals.

- .4 System operation, maintenance and testing must be simple; the system must also be easily expandable.
- .5 Damage caused by a defective device in a system must be limited to that device and must not affect other devices in the system.
- .6 To shield them fully from electromagnetic fields, all major metal parts (base frames, cabinets and desks) must be grounded to the buildings grounding grid. Grounds must be made in compliance with manufacturer's recommendations. All cable shielding must be grounded, but in a single point for each section unless otherwise indicated in the manufacturer's requirements.
- .7 The Contractor must take all necessary precautions to ensure proper operation of system devices within variances defined below, or consistent with variances defined by the manufacturer where these variances are more demanding. System devices must be designed to operate within the following environmental parameters:
 - .1 Devices installed indoors
 - .1 Temperature: 0° to 40° Celsius
 - .2 Humidity: 10 to 90 %
 - .2 Devices installed outdoors
 - .1 Temperature: -40° to 60° Celsius
 - .2 Humidity: 10 to 100 %
- .8 Coding of equipment and cables is planned to a standard to facilitate tracing.
 - .1 The Contractor is responsible for supply and installation of this coding.
 - .2 The Contractor must ensure that the various system subassemblies, equipment and devices are properly identified.
 - .3 All wiring, cables and connectors must be identified at both (2) ends and bear the same number in printed characters at each end, using a permanent marking technique resistant to water, solvent and oil.
- .9 Installation of stickers or labels indicating the name of the Contractor, a subcontractor or supplier must be approved by the Department's representative.

1.6 Documents/
samples to be
submitted

- .1 Documentation specifications
 - .1 All final support documentation supplied for the door/barrier/grille control system must be accompanied by a waiver of related copyright.
 - .2 Documentation must comply with the requirements of the statement of work document SE/AND-0101.
- .2 Preliminary design:
 - .1 The reference preliminary design plan was developed following review and approval of the preliminary design report (PDR) by the head of design or his representative. This plan must include the specifications, drawings and approved PDR.
 - .2 The Contractor must prepare and submit two (2) copies of the PDR

to the head of design and one (1) copy to the contract officer at least ten (10) days before the PDR review meeting. The PDR must include:

- .1 The specifications on performance consisting of operating diagrams for the proposed system. The equipment technical analysis and performance data must support confirmation of system specifications;
- .2 The preliminary equipment plans, including control consoles and equipment bays;
- .3 The list of standard equipment, including the part number, model, manufacturer's name and quantity for each item;
- .4 The customized equipment list, including the model and quantity for each item;
- .5 The operating diagrams for all customized equipment;
- .6 The conceptual drawings for all customized equipment;
- .7 The proposed plan for product insurance;
- .8 The proposed plan for maintenance;
- .9 The proposed plan for supply of replacement parts;
- .10 The proposed plan for training.

.3 Review of preliminary design:

- .1 The Contractor must take responsibility for organizing the PDR content review meeting. It must provide the premises for the meeting as well as all necessary facilities. The head of design will indicate any part of the PDR that does not meet CSC requirements.

.4 Final design:

- .1 The reference final design plan will be produced following the review and approval of the final design report (FDR) by the head of design. This serves as the basis for control of changes made to the equipment design and performance. The FDR must include:
 - .1 All components included in the reference preliminary design plan;
 - .2 Models of the command console, ergonomic considerations, etc. as required;
 - .3 Operational drawings and descriptions for customized equipment, including interface specifications;
 - .4 Installation drawings and instructions;
 - .5 The updated model and availability analysis based on the final design for the system and the equipment selected.
- .2 The FDR must be prepared in compliance with recommended commercial practices. Two (2) copies of the FDR must be submitted to the head of design at least ten (10) days before the FDR review meeting.

.5 Final design review:

- .1 A meeting to review the FDR content must be held. The Contractor must provide the premises for the meeting as well as all necessary

facilities. All of the Contractor's staff responsible for technical design of the system/equipment must be available.

1.7 General

- .1 The system must consist of standard equipment to the fullest extent possible. Use of new-design equipment must be limited to common interfaces, consoles or control panels or to single devices that cannot be obtained off the shelf.
- .2 The design specifically must strive to minimize the number of wires required between all system components.
- .3 Planning of the system must use a space diversity approach such that loss of one interconnection pathway does not adversely affect operation of the system as a whole.
- .4 CSC's Engineering Services Division has established technical specifications and standards that apply to equipment for specific electronic security systems, and these must meet very specific and demanding criteria for operational performance, described in the Electronic Standards. Technical acceptability of these systems means that equipment complies with application CSC specifications and standards.
- .5 The technical approval process includes an assessment of the system and subsystems in compliance with CSC specifications in one of CSC's institutions, or an assessment in a CSC institution where the effectiveness of the proposed technologies is verified when these must be applied under restrictive operating environment conditions.
- .6 CSC must also verify in detail compliance with technical specifications applicable to the system in question. If it deems necessary, CSC may require the supplier to organize a full demonstration on site. For certain specifications, CSC will rely on the results of tests conducted by the manufacturer in an independent testing facility deemed acceptable by CSC.
- .7 It is incumbent on the supplier to submit for CSC's assessment any change made to the products. Equipment certification is an ongoing process and a supplier may request an assessment at any time. CSC specifications and standards are available to any supplier on request. Any improvement or any new product must be submitted to the technical head of CSC's Engineering Services Division within a reasonable time before any call for tender process to allow sufficient time for assessment, which can take up to sixteen (16) months.
- .8 Any order of equipment placed before approval of the design report for the door/barrier/grille control system will be at the Contractor's risk. The head of design may authorize the purchase of certain items subject to long delivery delays at the time of the preliminary design study for the

proposed system or shortly thereafter.

1.8 Description of System

- .1 The Archambault Institution is already equipped with a PPA system. The existing PPA system is by the firm Senstars.
- .2 The Contractor must integrate the new PPA components into the existing PPA system. The design of the addition to the existing PPA system must conform to the technical specifications found in the document ES/SPEC-0600 (revision 2) Electronics Engineering Specification – Personal Portable Alarm System for Federal Correctional Institutions.
- .3 The new PPA alarm points must be programmed to be received on the Facility Alarm Indication System at the CCCS.
- .4 The Contractor shall provide for the addition of:
 - .1 Two (2) new receivers, one (1) inside and one (1) outside.
 - .2 Six (6) new Personal Portable Alarm devices.
- .5 The new receivers must connect to the existing receiver located in Local U206.

1.9 Replacement equipment

- .1 Support specifications
 - .1 Maintenance support and replacement part plans for the door/barrier/grille control system must comply with the requirements of statement of work document SE/AND-0101.
- .2 Maintenance and replacement parts
 - .1 The Contractor must supply maintenance support and replacement part supply plans for approval by the head of design. These plans must be submitted by the dates indicated on the calendar.
- .3 Maintenance plan
 - .1 The maintenance plan must describe the preventive maintenance (PM) approach, procedures and calendar, methods and response times for corrective maintenance corrective as well as the average repair time (MTTR) for all systems. The plan must recommend the tools, templates and test equipment, and must describe in detail the staff assignment method recommended for the system. The final maintenance support plan will be issued subject to approval by the head of design.
- .4 Replacement parts supply plan
 - .1 The replacement parts supply plan must include the list of replacement parts required and the recommended quantity for each. Recommendations on quantity must be supported by analysis of availability and system reliability and by available technical results. The Contractor must identify the replacement parts and components by their manufacturer's code number and with

references to the part numbers used by the equipment supplier.

- .5 List of replacement parts
 - .1 The list of replacement parts must include the following information:
 - .1 Replacement parts and subassemblies as well as recommended quantities;
 - .2 A list of references between supplier codes and manufacturer's code numbers;
 - .3 Unit prices and prices calculated for warehousing;
 - .4 Forecast service life or annual consumption for each part.
 - .2 The Contractor maintain an up-to-date replacement parts supply plan up to the end of the warranty period and must ensure that any change resulting from design modifications is incorporated into the list of replacement parts.

1.10 Warranty

- .1 Warranty provided in the contract: The following conditions are added to the general conditions. In the event of a contradiction between the two conditions, the more demanding conditions shall apply.
- .2 The warranty is applicable to all equipment devices and must include the cost of labour, equipment and materials for the following services:
 - .1 Preventive maintenance.
 - .2 Replacement and repair of defective parts.
 - .3 Technical support for any possible additions.
 - .4 Travel to the site.
- .3 During the warranty period, in the event of breakdown of one or more devices in the various systems, it must be possible to reach service staff at all times, 24 hours a day, 7 days a week. These service staff must travel to the site and locate the breakdown within four hours following the service call, and repair the breakdown as quickly as possible, to disrupt operations and facility security levels as little as possible.
- .4 The Contractor must maintain in its inventory the necessary quantity of replacement parts to comply with the requirements indicated.
- .5 Where a manufacturer provides a warranty greater than that requested in the general conditions for a piece of equipment, the Contractor must transfer that warranty to the system user.
- .6 The warranty may not be for less than one year from date of final acceptance of the work.

PART 2 - PRODUCTS

2.1 Materials/ equipment

- .1 System materials must meet the requirements in the reference document listed in section 1.2 "Reference Standard."
- .2 Conduits: compliant with section 26 05 34 - Conduits, fixtures and conduit connections.
- .3 Wiring and cable: based on manufacturer's indications, compliant with section 27 05 14A – Wiring and cable – For security systems.

2.2 System configuration

- .1 RECEIVER
 - .1 The receiver shall have the required sensitivity and selectivity to receive an alarm signal from all areas of a facility without interference from other institution RF communication equipment.
 - .2 The receiver shall be an ensemble that includes a receiver model #77000 from the manufacturer Senstar with an indoor or outdoor antenna, depending on the environment where it must be installed, no equivalent.
- .2 TRANSMITTER
 - .1 The PPA transmitter shall be a compact, lightweight unit, which can be carried or worn by the staff.
 - .2 It shall have enough effective radiated power to be able to provide complete PPA coverage from all areas of the institution.
 - .3 The transmitter shall be capable of transmitting at least 500 alarms of one (1) second duration from set of batteries.
 - .4 The batteries shall be easily accessible for quick changing.
 - .5 The transmitter shall weigh less than 200 grams (with batteries).
 - .6 The transmitter must be the model T1FG0210-001 from the manufacturer Senstar, no equivalent.
- .3 CARRYING CASE
 - .1 The contractor shall supply PPA transmitter carrying cases for belt or harness mounting as determined by the CSC Design Authority. The carrying case shall be able to be mounted either horizontal or vertical position.

PART 3 - EXECUTION

3.1 Summary of the work

- .1 Project CSC Archambault Institution, Refinishing Kitchen – Building U.
 - .1 There is an existing PPA system. The work included in the existing RFP must integrate with the existing systems. The receiver the Contractor must connect to is located in the electrical room U206.
 - .2 The Contractor must consult ADGA to receive recommendations

concerning the positioning of the antennas and the parametrization of the new alarm points.

3.2 Manufacturer's instructions

- .1 Compliance: comply with written manufacturer's requirements, recommendations and specifications, including any available technical bulletin, instructions appearing in the product catalogue, those appearing on product packaging and indications on technical fact sheets.

3.3 Installation

- .1 RECEIVER
 - .1 The device must be installed surface mounted;
 - .2 The connection must be concealed in an electrical box recessed in the wall;
 - .3 Anti-tampering screws must be used;
 - .4 The device must be installed so that it is not accessible from use of the kitchen.
- .2 Installation Specifications
 - .1 The system must be installed in compliance with the requirements of statement of work documents SE/AND-0101 and SE/AND-0102.
 - .2 The system must meet the requirements of the electronic technical specification document.
- .3 Documentation specifications
 - .1 All final documentation related to the system must be accompanied by a waiver of copyright. The documentation must comply with requirements of statement of work document SE/AND-0101.
- .4 Support specifications
 - .1 System maintenance and replacement parts must be provided in compliance with the requirements of statement of work document SE/AND-0101.
- .5 Training specifications
 - .1 Operator training and system maintenance training must comply with the requirements contained in statement of work document SE/AND-0101.

3.4 On-site quality control

- .1 The door/barrier/grille control system quality assurance program must comply with requirements of statement of work document SE/AND-0101.
- .2 All installation, as well as all test plans and acceptance tests must be performed in compliance with the requirements of statement of work document SE/AND-0101.
- .3 System test plan.
 - .1 The plan must contain the method used for testing, the tests to be

conducted, the criteria for pass/fail, the requirements for repetition of tests and the validation and approval instructions for all final reference design plan specifications. Before attending tests, the CSC representative will conduct a visual inspection and a mechanical inspection to ensure that system installation has been performed in compliance with the requirements.

- .4 Testing procedures. These procedures must be developed such that:
 - .1 All equipment supplied meets with the performance specifications;
 - .2 Each subsystem meets the applicable performance requirements;
 - .3 The system as a whole meets the performance requirements;
 - .4 The testing procedures contain steps to follow for each test and the anticipated results.
- .5 Make the necessary arrangements for the Department's representative assigned to the project to inspect the work related to handling, installation, application, protection and cleaning of the equipment. The Department's representative will submit written reports to validate whether work has been performed in compliance with contractual requirements.
- .6 Services of the Department's representative: convene the Department's representative to make recommendations on site regarding use of the product(s) and conduct periodic inspections to determine whether commissioning has been performed in compliance with his recommendations.
- .7 Plan site inspections at the following stages:
 - .1 Once products have been delivered and stored on the site, and preparatory and other preliminary work has been completed, but prior to start of equipment installation work covered by this section.
 - .2 Twice during the progress of work, when it has reached 33 and 60 percent respectively.
 - .3 Once work and cleaning have been completed.
- .8 The Department's representative will submit inspection reports within five days of the site inspection.

3.5 Control

- .1 Conduct inspections and testing with the Department's representative present.
 - .1 Supply the necessary tools, ladders and equipment.
 - .2 Ensure that subcontractors and departmental representatives are present at the time of the inspections.
- .2 Tests must be conducted in compliance with the approved plan and procedures.
- .3 The Contractor must notify CSC at least five (5) working days prior to the start of testing.

- .4 Visual inspection: inspection to assess quality of installation and assembly as well as overall appearance of the equipment, to ensure that the system complies with the contract documents, and must focus on the following points:
 - .1 Sturdiness of equipment mounting.
 - .2 Lack of damage due to installation.
 - .3 Compliance of device locations with revised shop drawings.
 - .4 Compatibility of equipment installation with the physical environment.
 - .5 Supply of all accessories.
 - .6 Identification of devices and coding of cabling.
 - .7 Correct placement of decals indicating ULC approval.
- .5 Technical inspection: inspection to verify that all systems and devices have been correctly installed, are free of defects and damage, and must focus on the following points:
 - .1 Measurement of voltage and amperage.
 - .2 Junctions/connections and equipment mounting.
 - .3 Measurement of signals and parameters, e.g. noise (dB), lighting (lux), transmission speed (baud).
 - .4 Compliance with manufacturer's installation specifications, documentation and instructions.
- .6 Operational inspection: inspection to ensure that performance of devices and systems complies with or exceeds established operating requirements, and must focus on the following points:
 - .1 Operation of each device, individually and in its environment.
 - .2 Operation of each device in association with a programmable calendar and/or with specific functions.
 - .3 Demonstration of the following functions:
 - .1 Interoperability with other security systems.
- .7 The Contractor must submit the final copies of test results for review and approval by CSC within ten (10) working days of the end of testing. It must provide two (2) copies of test reports, which must include:
 - .1 A summary description of the tests;
 - .2 Test results, including the test procedures conducted, which were checked by a CSC representative;
 - .3 Incident reports, including analysis of incidents and the corrective measures taken;
 - .4 Results of any tests that had to be repeated.

3.6 Cleaning and adjustment

- .1 Adjust the antenna.
- .2 In compliance with manufacturer's recommendations, clean system components, to remove packaging products, fingerprints and other marks.

END OF SECTION

PART 1 - GENERAL

- 1.1 Related sections
- .1 Section 01 74 19 – Management and elimination of construction/demolition waste.
 - .2 Section 27 05 14A – Wiring and cables – For security systems.
 - .3 Section 26 05 34 - Conduits, fixtures and conduit connections, for conduits.
- 1.2 Reference documents
- .1 Correctional Service Canada – Technical Services Branch – Electronic Systems
 - .1 SE/AND-0101 Statement of Electronic Engineering Work – Procurement and Installation of Electronic Security Systems.
 - .2 SE/AND-0102 Statement of Electronic Engineering Work – Quality control of supply and installation operations for electronic security systems.
- 1.3 Reference standards
- .1 Canadian Standards Association (CSA)/CSA International
 - .2 EIA-310-D Electronic Industry Association Standard for Racks, Panels and Associated Equipment
 - .3 Underwriters' Laboratories (UL)
 - .1 UL 1076-2005, Safety for Proprietary Burglar Alarm Units and Systems.
- 1.4 Definitions
- .1 UPS Uninterrupted Power Supply
 - .2 CSA Canadian Standards Association
 - .3 EIA Electronic Industries Association
 - .4 CCCS Central command and communication station
 - .5 CSC Correctional Service Canada
 - .6 FAIS Facility Alarm Indication System
- 1.5 Performance requirements
- .1 After-sales service (labour and parts) must not be for the exclusive use of the Contractor awarded the contract. Devices must be commercially available in the Montreal area and environs from other installers, at prices comparable to the competition.
 - .2 Secondary parts such as relays, timers, etc. must be solidly secured with screws or a rail. (Use of adhesive strips is prohibited).
 - .3 The system must be modular in design, consisting of independent basic mechanical units (cabinet, chassis, cards, printed circuits, connectors, power supplies, connection terminals, etc.). Each base unit must be easy to install or disassemble. Connections between units will be made by cables with connector terminals.
 - .4 System operation, maintenance and testing must be simple; the system

must also be easily expandable.

- .5 Damage caused by a defective device in a system must be limited to that device and must not affect other devices in the system.
- .6 To shield them fully from electromagnetic fields, all major metal parts (base frames, cabinets and desks) must be grounded to the buildings grounding grid. Grounds must be made in compliance with manufacturer's recommendations. All cable shielding must be grounded, but in a single point for each section unless otherwise indicated in the manufacturer's requirements.
- .7 The Contractor must take all necessary precautions to ensure proper operation of system devices within variances defined below, or consistent with variances defined by the manufacturer where these variances are more demanding. System devices must be designed to operate within the following environmental parameters:
 - .1 Devices installed indoors
 - .1 Temperature: 0° to 40° Celsius
 - .2 Humidity: 10 to 90 %
- .8 Coding of equipment and cables is planned to a standard to facilitate tracing.
 - .1 The Contractor is responsible for supply and installation of this coding.
 - .2 The Contractor must ensure that the various system subassemblies, equipment and devices are properly identified.
 - .3 All wiring, cables and connectors must be identified at both (2) ends and bear the same number in printed characters at each end, using a permanent marking technique resistant to water, solvent and oil.
- .9 Installation of stickers or labels indicating the name of the Contractor, a subcontractor or supplier must be approved by the Department's representative.

1.6 Documents/
samples to be
submitted

- .1 Documentation specifications
 - .1 All final support documentation supplied for the door/barrier/grille control system must be accompanied by a waiver of related copyright.
 - .2 Documentation must comply with the requirements of the statement of work document SE/AND-0101.
- .2 Preliminary design:
 - .1 The reference preliminary design plan was developed following review and approval of the preliminary design report (PDR) by the head of design or his representative. This plan must include the specifications, drawings and approved PDR.
 - .2 The Contractor must prepare and submit two (2) copies of the PDR to the head of design and one (1) copy to the contract officer at

least ten (10) days before the PDR review meeting. The PDR must include:

- .1 The specifications on performance consisting of operating diagrams for the proposed system. The equipment technical analysis and performance data must support confirmation of system specifications;
- .2 The preliminary equipment plans, including control consoles and equipment bays;
- .3 The list of standard equipment, including the part number, model, manufacturer's name and quantity for each item;
- .4 The customized equipment list, including the model and quantity for each item;
- .5 The operating diagrams for all customized equipment;
- .6 The conceptual drawings for all customized equipment;
- .7 The proposed plan for product insurance;
- .8 The proposed plan for maintenance;
- .9 The proposed plan for supply of replacement parts;
- .10 The proposed plan for training.

.3 Review of preliminary design:

- .1 The Contractor must take responsibility for organizing the PDR content review meeting. It must provide the premises for the meeting as well as all necessary facilities. The head of design will indicate any part of the PDR that does not meet CSC requirements.

.4 Final design:

- .1 The reference final design plan will be produced following the review and approval of the final design report (FDR) by the head of design. This serves as the basis for control of changes made to the equipment design and performance. The FDR must include:
 - .1 All components included in the reference preliminary design plan;
 - .2 Models of the command console, ergonomic considerations, etc. as required;
 - .3 Operational drawings and descriptions for customized equipment, including interface specifications;
 - .4 Installation drawings and instructions;
 - .5 The updated model and availability analysis based on the final design for the system and the equipment selected.

- .2 The FDR must be prepared in compliance with recommended commercial practices. Two (2) copies of the FDR must be submitted to the head of design at least ten (10) days before the FDR review meeting.

.5 Final design review:

- .1 A meeting to review the FDR content must be held. The Contractor must provide the premises for the meeting as well as all necessary facilities. All of the Contractor's staff responsible for technical

design of the system/equipment must be available.

1.7 General

- .1 The system must consist of standard equipment to the fullest extent possible. Use of new-design equipment must be limited to common interfaces, consoles or control panels or to single devices that cannot be obtained off the shelf.
- .2 The design specifically must strive to minimize the number of wires required between all system components.
- .3 Planning of the system must use a space diversity approach such that loss of one interconnection pathway does not adversely affect operation of the system as a whole.
- .4 CSC's Engineering Services Division has established technical specifications and standards that apply to equipment for specific electronic security systems, and these must meet very specific and demanding criteria for operational performance, described in the Electronic Standards. Technical acceptability of these systems means that equipment complies with application CSC specifications and standards.
- .5 The technical approval process includes an assessment of the system and subsystems in compliance with CSC specifications in one of CSC's institutions, or an assessment in a CSC institution where the effectiveness of the proposed technologies is verified when these must be applied under restrictive operating environment conditions.
- .6 CSC must also verify in detail compliance with technical specifications applicable to the system in question. If it deems necessary, CSC may require the supplier to organize a full demonstration on site. For certain specifications, CSC will rely on the results of tests conducted by the manufacturer in an independent testing facility deemed acceptable by CSC.
- .7 It is incumbent on the supplier to submit for CSC's assessment any change made to the products. Equipment certification is an ongoing process and a supplier may request an assessment at any time. CSC specifications and standards are available to any supplier on request. Any improvement or any new product must be submitted to the technical head of CSC's Engineering Services Division within a reasonable time before any call for tenders process to allow sufficient time for assessment, which can take up to sixteen (16) months.
- .8 Any order of equipment placed before approval of the design report for the door/barrier/grille control system will be at the Contractor's risk. The head of design may authorize the purchase of certain items subject to long delivery delays at the time of the preliminary design study for the proposed system or shortly thereafter.

1.8 Description of System

- .1 The Archambault Institution is already equipped with a Facility Alarm Indication System (FAIS). The existing FAIS is provided by the firm Senstars.
- .2 The Contractor shall plan for the addition of:
 - .1 Two (2) new static distress call buttons, one (1) inside the employee office (Room #3) and one (1) inside the office of the in charge of the kitchen (Room # 1).

1.9 Replacement equipment

- .1 Support specifications
 - .1 Maintenance support and replacement part plans for the door/barrier/grille control system must comply with the requirements of statement of work document SE/AND-0101.
- .2 Maintenance and replacement parts
 - .1 The Contractor must supply maintenance support and replacement part supply plans for approval by the head of design. These plans must be submitted by the dates indicated on the calendar.
- .3 Maintenance plan
 - .1 The maintenance plan must describe the preventive maintenance (PM) approach, procedures and calendar, methods and response times for corrective maintenance corrective as well as the average repair time (MTTR) for all systems. The plan must recommend the tools, templates and test equipment, and must describe in detail the staff assignment method recommended for the system. The final maintenance support plan will be issued subject to approval by the head of design.
- .4 Replacement parts supply plan
 - .1 The replacement parts supply plan must include the list of replacement parts required and the recommended quantity for each. Recommendations on quantity must be supported by analysis of availability and system reliability and by available technical results. The Contractor must identify the replacement parts and components by their manufacturer's code number and with references to the part numbers used by the equipment supplier.
- .5 List of replacement parts
 - .1 The list of replacement parts must include the following information:
 - .1 Replacement parts and subassemblies as well as recommended quantities;
 - .2 A list of references between supplier codes and manufacturer's code numbers;
 - .3 Unit prices and prices calculated for warehousing;
 - .4 Forecast service life or annual consumption for each part.
 - .2 The Contractor maintain an up-to-date replacement parts supply

plan up to the end of the warranty period and must ensure that any change resulting from design modifications is incorporated into the list of replacement parts.

1.10 Warranty

- .1 Warranty provided in the contract: The following conditions are added to the general conditions. In the event of a contradiction between the two conditions, the more demanding conditions shall apply.
- .2 The warranty is applicable to all equipment devices and must include the cost of labour, equipment and materials for the following services:
 - .1 Preventive maintenance.
 - .2 Replacement and repair of defective parts.
 - .3 Technical support for any possible additions.
 - .4 Travel to the site.
- .3 During the warranty period, in the event of breakdown of one or more devices in the various systems, it must be possible to reach service staff at all times, 24 hours a day, 7 days a week. These service staff must travel to the site and locate the breakdown within four hours following the service call, and repair the breakdown as quickly as possible, to disrupt operations and facility security levels as little as possible.
- .4 The Contractor must maintain in its inventory the necessary quantity of replacement parts to comply with the requirements indicated.
- .5 Where a manufacturer provides a warranty greater than that requested in the general conditions for a piece of equipment, the Contractor must transfer that warranty to the system user.
- .6 The warranty may not be for less than one year from date of final acceptance of the work.

PART 2 - PRODUCTS

2.1 Materials/ equipment

- .1 System materials must meet the requirements in the reference document listed in section 1.2 "Reference Standard."
- .2 Conduits: compliant with section 26 05 34 - Conduits, fixtures and conduit connections.
- .3 Wiring and cable: based on manufacturer's indications, compliant with section 27 05 14A – Wiring and cable – For security systems.

2.2 System configuration

- .1 STATIC DISTRESS CALL BUTTON DEVICE
 - .1 Unless otherwise specified, the device activation will be discreet but also accessible and silent.
 - .2 Device to have the option of remaining depressed or not following

its use.

- .3 The device must be a HUB-M 2020130 from Potter Electric, no equivalent.

PART 3 - EXECUTION

3.1 Summary of the work

- .1 Project CSC Archambault Institution, Refinishing Kitchen – Building U.
 - .1 There is an existing FAIS. The work included in the existing RFP must integrate with the existing systems. The alarm devices must connect in the cabinet located in local A003. There are presently 4 entry points available.

3.2 Manufacturer's instructions

- .1 Compliance: comply with written manufacturer's requirements, recommendations and specifications, including any available technical bulletin, instructions appearing in the product catalogue, those appearing on product packaging and indications on technical fact sheets.

3.3 Installation

- .1 STATIC DISTRESS CALL BUTTON DEVICE
 - .1 When it comes to an under the counter installation, the device must be easily accessible while being protected against accidental use. The wiring must be protected and secured against mechanical damage.
 - .2 When it comes to installation without an electrical box, the device must be screw secured in place, no glue.
- .2 Installation Specifications
 - .1 The system must be installed in compliance with the requirements of statement of work documents SE/AND-0101 and SE/AND-0102.
- .3 Documentation specifications
 - .1 All final documentation related to the system must be accompanied by a waiver of copyright. The documentation must comply with requirements of statement of work document SE/AND-0101.
- .4 Support specifications
 - .1 System maintenance and replacement parts must be provided in compliance with the requirements of statement of work document SE/AND-0101.
- .5 Training specifications
 - .1 Operator training and system maintenance training must comply with the requirements contained in statement of work document SE/AND-0101.

3.4 On-site quality control

- .1 The door/barrier/grille control system quality assurance program must comply with requirements of statement of work document SE/AND-0101.

- .2 All installation, as well as all test plans and acceptance tests must be performed in compliance with the requirements of statement of work document SE/AND-0101.
- .3 System test plan.
 - .1 The plan must contain the method used for testing, the tests to be conducted, the criteria for pass/fail, the requirements for repetition of tests and the validation and approval instructions for all final reference design plan specifications. Before attending tests, the CSC representative will conduct a visual inspection and a mechanical inspection to ensure that system installation has been performed in compliance with the requirements.
- .4 Testing procedures. These procedures must be developed such that:
 - .1 All equipment supplied meets with the performance specifications;
 - .2 Each subsystem meets the applicable performance requirements;
 - .3 The system as a whole meets the performance requirements;
 - .4 The testing procedures contain steps to follow for each test and the anticipated results.
- .5 Make the necessary arrangements for the Department's representative assigned to the project to inspect the work related to handling, installation, application, protection and cleaning of the equipment. The Department's representative will submit written reports to validate whether work has been performed in compliance with contractual requirements.
- .6 Services of the Department's representative: convene the Department's representative to make recommendations on site regarding use of the product(s) and conduct periodic inspections to determine whether commissioning has been performed in compliance with his recommendations.
- .7 Plan site inspections at the following stages:
 - .1 Once products have been delivered and stored on the site, and preparatory and other preliminary work has been completed, but prior to start of equipment installation work covered by this section.
 - .2 Twice during the progress of work, when it has reached 33 and 60 percent respectively.
 - .3 Once work and cleaning have been completed.
- .8 The Department's representative will submit inspection reports within five days of the site inspection.

3.5 Control

- .1 Conduct inspections and testing with the Department's representative present.
 - .1 Supply the necessary tools, ladders and equipment.
 - .2 Ensure that subcontractors and departmental representatives are present at the time of the inspections.

-
- .2 Tests must be conducted in compliance with the approved plan and procedures.
 - .3 The Contractor must notify CSC at least five (5) working days prior to the start of testing.
 - .4 Visual inspection: inspection to assess quality of installation and assembly as well as overall appearance of the equipment, to ensure that the system complies with the contract documents, and must focus on the following points:
 - .1 Sturdiness of equipment mounting.
 - .2 Lack of damage due to installation.
 - .3 Compliance of device locations with revised shop drawings.
 - .4 Compatibility of equipment installation with the physical environment.
 - .5 Supply of all accessories.
 - .6 Identification of devices and coding of cabling.
 - .7 Correct placement of decals indicating ULC approval.
 - .5 Technical inspection: inspection to verify that all systems and devices have been correctly installed, are free of defects and damage, and must focus on the following points:
 - .1 Measurement of voltage and amperage.
 - .2 Junctions/connections and equipment mounting.
 - .3 Measurement of signals and parameters, e.g. noise (dB), lighting (lux), transmission speed (baud).
 - .4 Compliance with manufacturer's installation specifications, documentation and instructions.
 - .6 Operational inspection: inspection to ensure that performance of devices and systems complies with or exceeds established operating requirements, and must focus on the following points:
 - .1 Operation of each device, individually and in its environment.
 - .2 Operation of each device in association with a programmable calendar and/or with specific functions.
 - .3 Demonstration of the following functions:
 - .1 Interoperability with other security systems.
 - .7 The Contractor must submit the final copies of test results for review and approval by CSC within ten (10) working days of the end of testing. It must provide two (2) copies of test reports, which must include:
 - .1 A summary description of the tests;
 - .2 Test results, including the test procedures conducted, which were checked by a CSC representative;
 - .3 Incident reports, including analysis of incidents and the corrective measures taken;
 - .4 Results of any tests that had to be repeated.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Treasury Board of Canada Secretariat (TBS), Occupational Safety and Health (OSH)
 - .1 Fire Protection Standard.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S526, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
 - .3 CAN/ULC-S527, Standard for Control Units for Fire Alarm Systems.
 - .4 CAN/ULC-S528, Manual Stations for Fire Alarm Systems, Including Accessories.
 - .5 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
 - .6 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S531, Standard for Smoke Alarms.
 - .8 CAN/ULC-S537, Standard for the Verification of Fire Alarm Systems.
- .3 The current edition of the references should always be used.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for multiplex fire alarm system and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Indicate on shop drawings:
 - .1 Detail assembly and internal wiring diagrams for control units. Consoles.
 - .2 Overall system riser wiring diagram identifying control equipment initiating zones signaling circuits; identifying terminations, terminal numbers, conductors and raceways.
 - .3 Details for devices.
 - .4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.

- .5 Step-by-step operating sequence, cross referenced to logic flow diagram.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system for incorporation into manual.
- .3 Include:
 - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESCRIPTION

- .1 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.
- .2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general two-stage alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to monitoring agency.
- .3 Zoned, two stage.

- .4 Modular system.
- .5 Operation of system shall not require personnel with special computer skills.
- .6 System to include:
 - .1 New signaling circuit card.
 - .2 Output circuits.
 - .3 Auxiliary circuits.
 - .4 Wiring.
 - .5 Manual and automatic initiating devices.
 - .6 Audible signalling devices.
 - .7 End-of-line resistors.
 - .8 Programming changes to graphic editor.
- .7 Equipment and devices: ULC listed and labelled and supplied by same manufacturer as the existing system.
- .8 Audible signal devices: to CAN/ULC-S524.
- .9 Control unit: to CAN/ULC-S527.
- .10 Manual pull stations: to CAN/ULC-S528.
- .11 Smoke detectors: to CAN/ULC-S529.
- .12 Smoke alarms: to CAN/ULC-S531.
- .13 Regulatory Requirements:
 - .1 To TBS Fire Protection Standard.
 - .2 Subject to Fire Commissioner of Canada (FC) approval.
 - .3 Subject to FC inspection for final acceptance.
 - .4 To Canadian Forces Fire Marshal approval.
 - .5 System components: listed by ULC and comply with applicable provisions of NBC, Provincial Building Code, and meet requirements of local authority having jurisdiction.

2.2 SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY

- .1 The operation will be such as the existing system.

2.3 WIRING

- .1 Twisted copper conductors: rated 120 V.
- .2 To initiating circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

- .5 All wiring of detection loop and signalisation circuit must be class A configuration.
- .6 All the wiring to be installed in metallic conduit.
- .7 All wiring to be FT4 and FA S105 certified.

2.4 MANUAL ALARM STATIONS

- .1 Addressable manual pull station.
 - .1 Pull lever, rod, semi-flush wall mounted type, double action, 2 stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.
 - .2 Operated by the key for prison sector.

2.5 AUTOMATIC ALARM INITIATING DEVICES

- .1 Addressable smoke detector.
 - .1 Photo-electric type.
 - .2 Electronics to communicate detector's status to addressable module/transponder.
 - .3 Detector address to be set on detector base in field.

2.6 AUDIBLE SIGNAL DEVICES

- .1 Bells: 24 V dc.
- .2 Bells: vibrating type, 24 V dc. The same model as the existing.

2.7 END-OF-LINE DEVICES

- .1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.8 ANCILLARY DEVICES

- .1 Remote relay unit to initiate fan, flow indicator, valve, door controller and kitchen equipment shutdown.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fire alarm installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524 and TB Fire Protection Standard.
- .2 Install manual alarm stations and connect to alarm circuit wiring.
- .3 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .4 Connect alarm circuits to main control panel.
- .5 Install bells as indicated and connect to signalling circuits.
- .6 Connect signalling circuits to main control panel.
- .7 Install end-of-line devices.
- .8 Install remote relay units to control auxiliary function.
- .9 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .10 Splices are not permitted.
- .11 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .12 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .13 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
- .2 Fire alarm system:
 - .1 Test such device and alarm circuit to ensure manual stations, thermal detectors transmit alarm to control panel and actuate first stage alarm.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
 - .4 Addressable circuits system style DCLA:

- .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .3 Provide final PROM program re-burn for system Departmental Representative incorporating program changes made during construction.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

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

3.6 CLOSEOUT ACTIVITIES

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

END OF SECTION

PART 1 - GENERAL**1.1 GENERAL CLAUSES**

- .1 General Clauses and Complementary General Clauses apply to works described in this section.

1.2 DEFINITIONS

- .1 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.
- .2 Rock excavation: excavation of material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral with its parent mass, and boulders or rock fragments having individual volume in excess of 1 cubic meter. If the individual volume exceeds 1 cubic meter, immediately notify the Departmental representative and follow his instructions.
- .3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.3 SAMPLES

- .1 Contractor shall submit to soil laboratory chosen by the Departmental representative the source of backfill materials and for testing and approval, a sample of all granular material to be used as fill at least 10 days before beginning backfilling operations.

1.4 PROTECTION OF EXISTING FEATURES

- .1 Protect existing buildings and surface features which may be affected by work from damage while work is in progress and repair damage resulting from work.

1.5 WORK SURVEILLANCE

- .1 The Departmental representative may delegate laboratory to represent the Departmental representative on site for all matters concerning soil quality, examination of bottom of excavation and execution of compacted backfill; laboratory is entitled to issue directives to contractor who must conform to them.
- .2 Contractor to cooperate with laboratory personnel and to lend equipment on site so that work can be executed rapidly and efficiently.
- .3 Laboratory is authorized to stop backfilling operations in order to verify the compaction of backfill material already in place.

- .4 Contractor may not ask for an extra caused by interruptions of his work because of laboratory operations.
- .5 Compaction tests to be performed for every 100 m3 of backfill.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Type 1 fill: clean, hard, durable crushed gravel or stone, free from shale, clay, friable materials, organic matter and other deleterious substances and graded within the following limits when tested to Ministère des Transports du Québec standards and giving a smooth curve without sharp breaks when plotted on a semi-log chart. Material to be DB certified.

<u>Sieve designation</u>	<u>% passing</u>
31.5 mm	100
20 mm	90 - 100
14 mm	68 - 93
5 mm	35 - 60
1.25 mm	15 - 38
0.315 mm	5 - 17
0.080 mm	2 - 7

PART 3 - EXECUTION

3.1 SOILS REPORT

- .1 Follow recommendations contained in soils investigation report No SCCG1-00011 433-00-55-00 issued by EXP the 27th of June 2011.

3.2 STOCKPILING

- .1 Stockpile fill materials in areas designated by the Departmental representative. Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.

3.3 DEWATERING

- .1 Keep excavations free of water while work is in progress.
- .2 Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction.

3.4 EXCAVATION

- .1 Excavate to lines, grades, elevations and dimensions indicated for the installation, the construction and inspection of the prescribed work.
- .2 Dispose of surplus and unsuitable excavated material off site.
- .3 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .4 Notify the Departmental representative when soil at bottom of excavation appears unsuitable and proceed as directed by the Departmental representative.
- .5 Obtain the Departmental representative's approval of completed excavation.
- .6 Remove unsuitable material from trench bottom to extent and depth directed by the Departmental representative.
- .7 Where required due to unauthorized over-excavation, correct as follows:
 - .1 Fill under bearing surfaces and footings with concrete specified for footings.
 - .2 Fill under other areas with Type 2 fill compacted to a minimum of 95% modified Proctor.
- .8 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil, subjected to soils laboratory's approval.

3.5 FILL TYPES AND COMPACTION

- .1 Use fill of types as indicated or specified below. Unless otherwise specified, compact to following densities:
 - .1 Type 1: 95% modified Proctor.
- .2 Exterior side of perimeter walls: fill to subgrade level with type fill specified on the Departmental representative drawings.

The use of shale or other deleterious material for compacted fill under slabs on grade or footings is strictly forbidden.

3.6 BACKFILLING

- .1 Do not proceed with backfilling operations until the Departmental representative has inspected and approved installations.
- .2 Areas to be backfilled to be free from debris, snow, ice, water or frozen ground.

- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Backfilling around installations.
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Place layers simultaneously on both sides of installed work to equalize loading. Difference not to exceed 150 mm.
 - .3 Place material by hand under, around and over installations until 600 mm of cover is provided. Dumping material directly on installations will not be permitted.
- .5 Place backfill material in uniform layers not exceeding 200 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .6 If specified on drawings, install drainage as per the Departmental representative's instructions.
- .7 Owner will pay the costs of tests.

3.7 INSPECTION AND TESTING

- .1 Compaction and material testing to be performed by laboratory chosen by owner.

END OF SECTION



La nouvelle identité de **Laboratoire de Construction 2000**

Laval, le 27 juin 2011

Madame Isabelle Roy

Gestionnaire de projets
Service correctionnel du Canada
321, chemin de l'Aéroport
La Macaza (Québec) J0T 1R0

OBJET : ÉTUDE GÉOTECHNIQUE

Projet : Affaissement de la dalle du Bloc « U » -
Établissement Archambault à Sainte-Anne-des-Plaines

N/Réf. : SCCG1-00011433-00-55-00

V/Réf. : 21301-11-1588827/A (1641447)

Madame,

Nous vous transmettons ci-joint notre rapport sur l'étude géotechnique effectuée par notre firme pour le projet cité en titre.

Les travaux de reconnaissance sur le chantier ont été effectués sous la supervision de madame Audrey Tremblay, géologue, tandis que madame Valérie Seigneur, ingénieure et monsieur André Proulx, ingénieur, ont rédigé le présent rapport.

Nous espérons qu'il sera à votre entière satisfaction et nous vous remercions de nous avoir permis de participer à la réalisation de votre projet.

Veuillez agréer, Madame, l'expression de nos sentiments les meilleurs.

Valérie Seigneur, ing., M.Sc.A.

VS/cfp

P.j.

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Les Services **exp** inc.





- **Service correctionnel du Canada**

**Étude géotechnique
Affaissement de la dalle du Bloc « U » –
Établissement Archambault à
Sainte-Anne-des-Plaines**

Rapport
Final

Projet n°
N/Ref. : SCCG1-00011433-00-55-00
V/Ref. : 21301-11-1588827/A (1641447)

Préparé par :
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4500, rue Louis-B.-Mayer
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Tél. : 450 682-8013
Télec. : 450 682-1182

Date :
2011-06-27

Service correctionnel du Canada

Étude géotechnique Affaissement de la dalle du Bloc « U » – Établissement Archambault à Sainte-Anne-des-Plaines

Rapport
Final

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Approuvé par :



Valérie Seigneur, ingénieure, M.Sc.A.
N° O.I.Q. : 123899

Date :
2011-06-27



La nouvelle identité de **Laboratoire de Construction 2000 inc.**

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SCCG1-00011433-00-55-00-1/1 (1 page)
- Annexe B : Notre explicative et Généralités et portée de l'étude (2 pages)
Rapports de forage (10 pages)
- Annexe C : Résultats d'essais de laboratoire (6 pages)

Liste de distribution

Rapport distribué à :

Nom	Coordonnées
Madame Isabelle Roy, gestionnaire de projets (4 copies papier et 1 copie PDF)	Service correctionnel du Canada Établissement La Macaza 321, Chemin de l'Aéroport La Macaza (Québec) J0T 1R0

1. Introduction

Les services professionnels des Services **exp** inc. (la nouvelle identité de Laboratoire de Construction 2000 inc.) ont été retenus par *Service correctionnel du Canada* afin de réaliser une expertise de sols en rapport avec des dommages observés dans le Bloc « U » situé à l'établissement Archambault à Sainte-Anne-des-Plaines (Québec).

Les travaux de reconnaissance sur le terrain avaient pour buts de déterminer la nature et les propriétés des sols en place ainsi que le niveau de l'eau souterraine au moyen de six (6) forages profonds localisés à l'intérieur du bâtiment existant, et ce, tel que convenu dans l'offre de services datée du 4 février 2011. Les informations recueillies lors de ces sondages nous ont permis d'identifier les causes probables, d'un point de vue géotechnique, à l'origine des mouvements du bâtiment et d'identifier des pistes de solution correctives envisageables.

Les investigations réalisées dans le cadre du présent mandat ne couvrent pas la caractérisation environnementale des sols ou les matériaux de remblai éventuellement présents sur le site ni la présence ou l'absence de sources de contamination réelles ou potentielles de contamination. Le présent rapport ne discute donc pas de considérations environnementales.

Le présent rapport contient dans un premier temps, une brève description du site et de la problématique suivie d'une description des méthodes de reconnaissance, une description détaillée de la nature et des propriétés des sols en place, ainsi que des conditions de l'eau souterraine. Il contient finalement une section où les résultats sont discutés et où les recommandations appropriées du point de vue de la géotechnique sont formulées.

2. Description du site

Le site à l'étude se trouve à l'Ouest de la Montée Gagnon (Route 335), entre le Rang du Trait-Carré au Nord et le Rang Lepage au Sud (voir plan-clé ci-joint). L'établissement Archambault est accessible par le boulevard Gibson et est localisé dans un secteur agricole.

Ce rapport concerne uniquement le Bloc « U ». Selon les informations disponibles, la majorité des activités auxquelles les détenus y participent de jour sont situés dans ce Bloc. On y retrouve un secteur académique, un secteur industriel comprenant plusieurs ateliers, dont une buanderie, et un secteur de réception/expédition des marchandises.

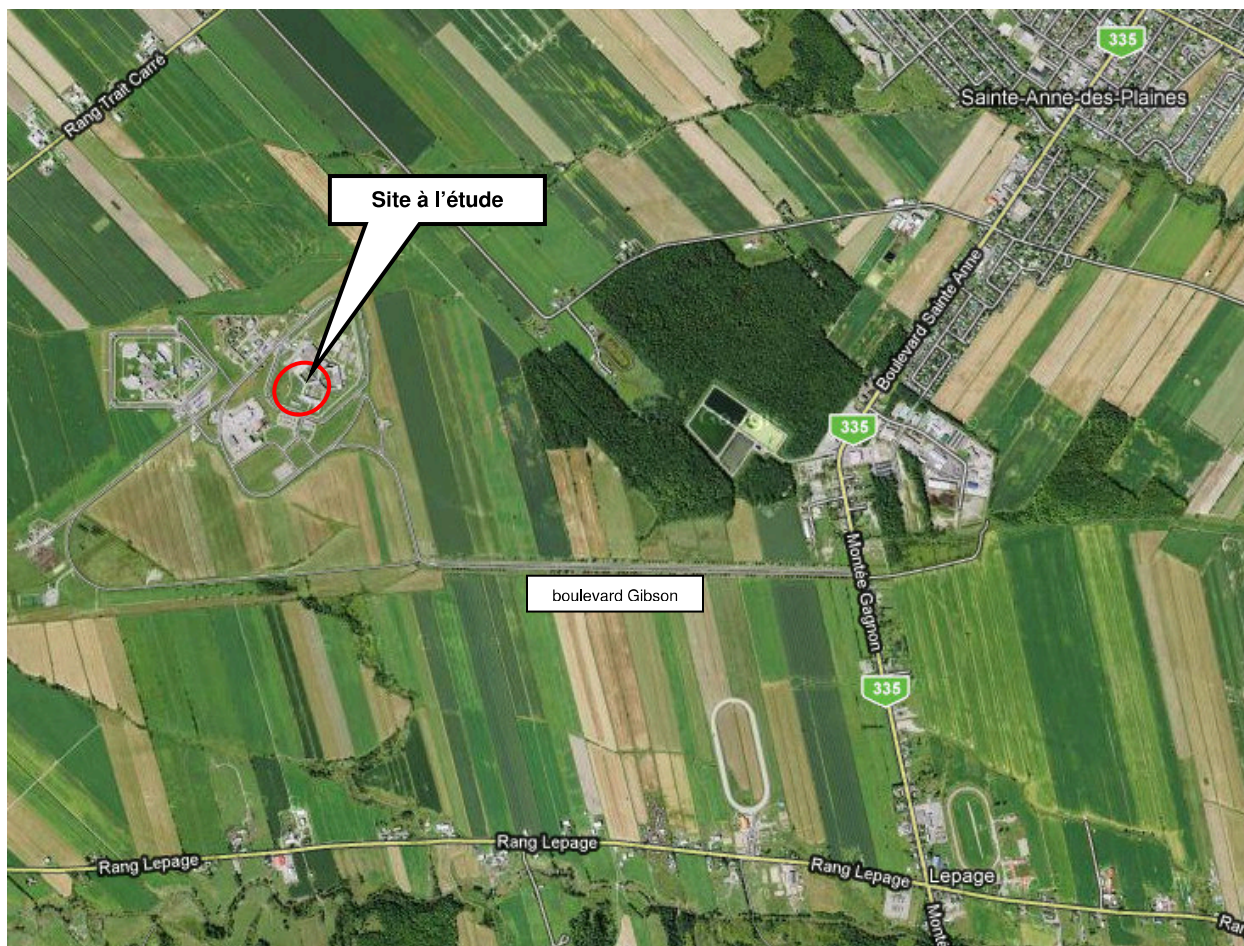


Figure No 1 : Plan-clé du site à l'étude (réf. : image non datée tirée du site Google Maps)

3. Description de la problématique

Selon les informations obtenues, depuis quelques mois, un affaissement de la dalle sur sol a été constaté dans le Bloc « U ». Toutefois, seule la dalle sur sol se serait affaissée. Ce bâtiment repose sur des fondations profondes de type pieux. Toujours selon les renseignements fournis, la fondation, les colonnes et les structures du toit et de la passerelle située au-dessus du corridor principal semblent stables. L'affaissement de la dalle aurait provoqué une fissuration de plusieurs cloisons intérieures de blocs de béton qui reposent sur cette dalle. Les cloisons intérieures de blocs ne sont pas renforcées par des barres d'armature. Il est à noter que plusieurs éléments de tuyauterie (eau chaude, eau froide, vapeur, conduits électriques, etc.) et conduits de ventilation traversent ces cloisons. Dans certains cas, les blocs situés au-dessus de ces éléments de tuyauterie et de ces conduits reposent directement sur ceux-ci et pourraient, le cas échéant, entraîner des bris, si la situation n'est pas corrigée.

4. Travaux d'investigation

Les travaux d'investigation géotechnique visant à déterminer la nature et certaines propriétés des sols à l'emplacement à l'étude ont été effectués sur le terrain et en laboratoire.

4.1 Travaux sur le terrain

Compte tenu des contraintes reliées aux activités du site, les travaux sur le terrain se sont déroulés de soir et de nuit les 13, 14, 18 et 19 avril 2011 suivant le programme préalablement établi en accord avec les divers intervenants sur le projet. Ces travaux ont consisté en la réalisation de six (6) forages incluant trois (3) profils scissométriques et un (1) essai de pénétration dynamique à l'intérieur du Bloc « U ».

La vérification, auprès des autorités compétentes, de la position des services publics souterrains (égouts, aqueduc, gaz, électricité et téléphone) ainsi que les services privés souterrains a été effectuée préalablement à la réalisation des travaux.

Les travaux de localisation des forages convenus ont été effectués par nos services à l'aide du plan de l'annexe « A » qui accompagnait l'appel d'offre du 17 mars 2011 mais, l'emplacement des forages a été établi et implanté sur les lieux par le représentant du projet en tenant compte des contraintes du site.

Aucun relevé de nivellement n'était prévu dans le cadre du présent mandat. Toutes les profondeurs mentionnées dans le présent rapport se réfèrent au dessus de la dalle sur sol actuelle au droit des forages.

La localisation des forages a été faite par rapport à des repères fixes présents sur les lieux. La position des forages est montrée sur le croquis de localisation SCCG1-00011433-00-55-00-1/1 inclus à l'annexe A du rapport.

Les forages ont été exécutés à l'aide d'une foreuse montée sur chenilles et en utilisant des tubages de calibre NW (89 millimètres de diamètre) enfoncés par rotation. Ces forages ont atteint une profondeur variant entre 9,1 et 25,8 mètres sous la surface de la dalle.

Dans un premier temps, la dalle a été carottée, à l'exception des forages F-2 et F-3 où la dalle avait déjà été carottée au préalable par une autre firme. Dans un second temps, pour le sol sous-jacent à la dalle, un carottier normalisé de type cuillère fendue de 51 millimètres de diamètre a été utilisé pour le prélèvement d'échantillons remaniés et pour la mesure de l'indice « N » de l'essai de pénétration standard (NQ 2501-140). Cet indice permet d'estimer la compacité ou la consistance des sols traversés. Dans les sols de nature cohérente, quatorze (14) échantillons intacts ont été prélevés à l'aide de tubes à paroi mince de type Shelby de 70 millimètres de diamètre intérieur. Les cailloux et/ou les blocs ont été échantillonnés avec un carottier de calibre NQ.

Pendant l'avancement des forages, des mesures de la résistance au cisaillement ont été effectuées à l'aide d'un scissomètre de chantier Nilcon à même les trous de forage (NQ 2501-200). Les mesures ont été faites dans le prolongement des forages F-2, F-4 et F-5 entre 3,0 et 10,0 mètres sous la surface actuelle de la dalle en adoptant un intervalle de mesure d'un mètre.

Un essai de pénétration dynamique à la pointe conique standard (50 millimètres de diamètre) a été exécuté dans le prolongement du forage F-3 jusqu'à une profondeur de 24,84 mètres sous la surface actuelle de la dalle. L'essai de pénétration dynamique permet la mesure de l'indice « N_c »; celui-ci peut être corrélé avec l'indice « N » de l'essai de pénétration standard. Cet essai sert à évaluer l'homogénéité et l'état de densité des sols traversés et à déterminer la profondeur du refus à l'enfoncement.

Tous les travaux de terrain ont été réalisés sous la supervision d'un technicien. Mentionnons, d'autre part, que suite aux travaux, la carotte de béton a été remise dans le trou de forage et la surface refermée avec un mélange de béton pré-ensaché de 40 MPa. Les rapports de forage inclus à l'annexe B présentent les renseignements recueillis sur le terrain.

4.2 Laboratoire

4.2.1 Essais géotechniques

Tous les échantillons prélevés ont été acheminés au laboratoire où ils ont été soumis à une identification visuelle par un technicien spécialisé.

Subséquentement, le programme d'essais de laboratoire suivant a été réalisé :

Tableau No 1 : Analyses de laboratoire

Essais	Norme	Nombre
Analyse granulométrique par tamisage	LC 21-040	5
Extraction (tube), description visuelle et entreposage	---	14
Teneur en eau naturelle (w)	LC 21-200	19
Pénétromètre à cône suédois	NQ 2501-110	9
Consolidation œdométrique	ASTM D 2435	1
Limites d'Atterberg (cône suédois)	NQ 2501-092	2

Les courbes granulométriques obtenues ainsi que la courbe de l'essai de consolidation œdométrique sont incluses à l'annexe C du rapport. À noter que tous les échantillons prélevés durant les sondages et n'ayant pas servi au cours des essais de laboratoire seront conservés pour une période de six (6) mois à compter de la date d'émission de ce rapport, après quoi, ils seront détruits à moins qu'entre-temps un avis écrit quant à leur destination nous soit transmis.

5. Nature et propriétés des sols

Tous les forages ont été réalisés à l'intérieur du Bloc « U » et tous les planchers des pièces étaient composés d'une dalle sur sols de béton de ciment.

Les forages ont permis d'établir, à leur emplacement, la stratigraphie présentée dans les paragraphes qui suivent. En résumé, directement sous la dalle de béton de ciment ou sous les vides recoupés, des remblais pulvérulents variant de 1,0 et 1,8 mètres d'épaisseur ont été interceptés suivis d'un important dépôt d'argile silteuse de consistance *molle* à *raide*. Plus en profondeur à 24,2 m par rapport à la surface, un dépôt de blocs, cailloux et gravier a été recoupé au droit de F-4 et ce, jusqu'à la fin de ce forage à 25,8 mètres. D'autre part, un essai de pénétration dynamique a été réalisé dans le forage F-3 jusqu'au refus rencontré à 24,8 m de profondeur.

5.1 Dalle de béton de ciment

Directement à la surface des forages, une dalle de béton de ciment variant de 165 à 205 millimètres d'épaisseur est rencontrée. Il est à noter que la dalle avait déjà été carottée au droit des forages F-2 et F-3. L'épaisseur de la dalle à ces endroits a donc été mesurée sur les parois du trou de forage. De l'armature a été notée au droit de F-6. Sous la dalle, des vides de 35 mm (F-1), de 32 mm (F-3), de 25 mm (F-5) et de 10 mm (F-6) ont été notés entre la dalle et le remblai.

Également, une membrane de plastique (coupe-vapeur) a été observée sous la dalle au droit de F-2 et de F-6.

5.2 Remblais

Sous la dalle de béton de ciment, des remblais sont interceptés sur une épaisseur qui varie entre 1,05 et 1,78 mètre. La première couche de remblai (coussin) se compose de pierre concassée, s'apparentant à un matériau de type MG-20 selon la norme NQ 2560-114, sur une épaisseur variant de 0,41 à 1,03 mètre. La seconde couche se compose soit de sable, de silt et de gravier en proportions variables (F-1, F-5 et F-6), soit d'argile silteuse (F-3) ou soit de ces deux sous couches (F-2 et F-4).

Les propriétés géotechniques ont été mesurées en laboratoire sur des échantillons représentatifs. Les principaux résultats sont regroupés au tableau No 2.

Tableau No 2 : Analyses granulométriques sur les remblais

Sondage / Échantillon	Profondeur (mètre)	Proportions des constituants (%)			Teneur en eau (%)
		Gravier	Sable	< 80 µm	
F-2 / CF-2	0,61 à 1,22	46	34	20	---
F-3 / CF-1	0,23 à 0,61	43	45	12	---
F-5 / CF-2 + CF-3	0,20 à 1,22	51	36	13	---
F-6 / CF-1	0,20 à 0,61	28	52	20	3
F-6 / CF-2 (3 de 3)	0,94 à 1,22	0	86	14	---

5.3 Dépôt d'argile silteuse

Sous les couches précitées au droit de tous les forages, un important dépôt naturel d'argile silteuse est rencontré entre 1,24 et 1,98 m de la surface de la dalle. Tous les forages ont pris fin dans ce dépôt entre 9,09 et 16,46 m de profondeur à l'exception du forage F-4 qui a recoupé ce dépôt sur une épaisseur totale de 22,25 m. De couleur brun grisâtre en surface à gris en profondeur, le dépôt se compose d'une argile silteuse avec des traces de sable et est classifié « CH » selon la classification unifiée des sols (U.S.C.S.). Par endroits, la présence de coquillage a été notée.

Le dépôt présente, dans sa portion supérieure, sur le premier mètre et demi environ, une argile altérée et brunâtre communément appelée la croûte. Une teneur en eau de 50 % a été mesurée en laboratoire dans cette portion du dépôt. Également, les résistances au cisaillement non drainé mesurées in-situ au scissomètre « Nilcon » qualifient l'argile dans la portion « croûte » de *raide* (Cu de 69 et 90 kPa).

Plus en profondeur dans le corps du dépôt, soit autour de 2,5 à 3,0 mètres de la surface de la dalle, les teneurs en eau mesurées varient entre 55 et 79%. Selon les résultats des essais au pénétromètre à cône Suédois, l'argile est de consistance *molle* à *ferme* (principalement entre 4 et 7 m) devenant *raide* en profondeur (Cu de 16 à 58 kPa). L'argile est très sensible à extrêmement sensible au remaniement ($10 < St < 292$). Quant aux résistances au cisaillement non drainé mesurées in-situ au scissomètre « Nilcon », elles qualifient l'argile dans la portion « corps » de *ferme* (Cu de 25 à 47 kPa).

Les limites d'Atterberg au cône suédois qualifient la plasticité de l'argile de élevée. L'essai de consolidation oedométrique, réalisé sur un échantillon intact prélevé au droit du forage F-3 à 3,47 m de profondeur, indique que l'argile est surconsolidée avec une pression de préconsolidation de 133 kPa et une contrainte effective à ce niveau de 39 kPa.

Les principaux résultats sont regroupés aux tableaux Nos 3 et 4.

Tableau No 3 : Essais en laboratoire sur le dépôt d'argile silteuse – Teneur en eau et résistance au cisaillement

Propriétés caractéristiques	F-1 TM-7	F-1 TM-9	F-1 TM-11	F-1 TM-12	F-1 TM-13	F-2 CF-4 ⁽¹⁾	F-3 TM-6	F-3 TM-8	F-3 TM-10	F-3 TM-11	F-3 CF-14	F-6 TM-6	F-6 TM-8	F-6 TM-10	F-6 TM-11	F-6 TM-12
Profondeur (m)	3,05	4,57	6,10	7,62	9,14	1,83	3,05	4,57	6,10	7,62	12,19	3,05	4,57	6,10	7,62	8,53
Teneur en eau w (%)	62	76	78	55	69	50	61 et 62	73 et 79	78	73	71	61	73	78	62	70
Résistance au cisaillement intact C _u (kPa)	44	17	20	58	---	---	35	16	26	---	---	20	23	---	---	---
Résistance au cisaillement remanié C _{ur} (kPa)	3,7	0,7	0,5	0,2	---	---	3,0	0,5	0,3	---	---	2,1	0,3	---	---	---
Sensibilité au remaniement S _i	12	24	40	292	---	---	12	32	85	---	---	10	75	---	---	---

(1) Échantillon provenant de la portion de la croûte de l'argile

Tableau No 4 : Essais en laboratoire sur le dépôt d'argile silteuse – Limites d'Atterberg et essai consolidation

Propriétés caractéristiques	F-3 TM-6	F-3 TM-8
Limite de liquidité w _L (%)	65	61
Limite de plasticité w _p (%)	23	24
Indice de plasticité I _p (%)	42	37
Indice de liquidité I _L	0,93	1,49
Indice des vides initial e ₀	1,8	---
Coefficient de recompression C _r	0,01	---
Coefficient de compression C _c	1,36	---
Pression préconsolidation σ'_p (kPa)	133	---
Pression verticale estimée σ'_{vo} (kPa)	39	---
Rapport de surconsolidation OCR	3,4	---

5.4 Dépôt de blocs, cailloux et gravier

Au droit de F-4, un dépôt de blocs, cailloux et gravier a été recoupé sous le dépôt d'argile silteuse à 24,23 mètres de profondeur. Le forage F-4 a pris fin dans ce dépôt à 25,76 mètres de profondeur. Il est à noter que l'utilisation d'un carottier a été nécessaire pour permettre l'avancement du forage dans ce dépôt.

5.5 Refus

Le forage F-3 s'est poursuivi sous 16,46 m de la surface de la dalle jusqu'au refus rencontré à 24,84 m de profondeur par un essai de pénétration dynamique sans prélèvement d'échantillon. Les sols traversés ont une consistance estimée de *très molle* à *raide* (0 à 53 coups/30 cm – moyenne de 18) et ce, jusqu'à un refus (100 coups/30 cm) intercepté à 24,84 m de profondeur.

6. Eau souterraine

Compte tenu des contraintes reliées au site et en accord avec la responsable du projet, aucun tube perforé n'a été laissé en place dans les trous de forage. Par conséquent, aucun relevé du niveau de l'eau souterraine n'a pu être effectué. Cependant, les observations de chantier indiquaient que les échantillons étaient saturés à partir de 1,22 mètre de profondeur au droit du forage F-3, ce qui pourrait être interprété comme étant le fait qu'ils ont été prélevés sous le niveau de la nappe phréatique (probablement une nappe perchée).

Selon un rapport géotechnique antérieur réalisé sur le site, le niveau de l'eau souterraine a été mesuré, au droit de forages situés à l'extérieur dans le secteur du Bloc « U », entre 0,73 et 0,84 mètre de profondeur par rapport à la surface du sol (forages TF-02-11 et TF-08-11) en date du 13 avril 2011 (rapport géotechnique de la firme LMV, dossier No 025-P039008-0100-GE-0001-00 daté du 21 avril 2011). Toutefois, à la lumière des renseignements disponibles, il n'est pas possible de relier ces niveaux d'eau à nos forages puisque le niveau de la surface du sol au droit de ces forages extérieurs et celui de la dalle du Bloc « U » ne sont pas connus.

7. Conclusions et recommandations

7.1 Portée et limitation du rapport

Les conclusions et recommandations formulées dans les paragraphes qui suivent sont basées sur l'hypothèse de la représentativité, sur l'ensemble du site à l'étude, des conditions géotechniques relevées au droit des forages implantés dans le cadre du présent mandat; ces recommandations reposent également sur les informations qui nous ont été transmises par le client au moment de la rédaction du présent rapport et dont il est fait état ci-après.

Le présent rapport doit être utilisé uniquement qu'à des fins de conception dans le contexte du projet décrit ci-après, et non pour des fins de construction. Nos conclusions et recommandations sont valides uniquement sur le site à l'étude et ne pourront être utilisées sur d'autres terrains, même contigus, sans avoir fait l'objet d'une étude complémentaire.

Nous devons être avisés de toute modification dans la localisation, la nature ou la conception du projet afin d'en évaluer l'impact et, au besoin, de modifier les recommandations formulées dans le présent rapport.

Les conditions rencontrées entre les forages ou ailleurs sur le site peuvent éventuellement différer de celles observées à l'emplacement des forages. Dans cette optique, nous recommandons que les excavations soient inspectées par un représentant de notre firme afin de s'assurer de la représentativité des forages et, le cas échéant, de détecter toute particularité qui serait susceptible d'affecter nos conclusions et recommandations.

Les directives du Code national du bâtiment (CNB), édition 2005, et plus particulièrement les sections 4.1 et 4.2 du code ainsi que les commentaires J et K de l'annexe A dudit code, ont été considérées dans la préparation du présent rapport, notamment dans les calculs des capacités portantes.

7.2 Description du projet

Selon les renseignements obtenus, un affaissement de la dalle sur sol a été constaté dans le Bloc « U ». Dans l'objectif d'identifier la ou les cause(s) probable(s) de cet affaissement, différents mandats ont été octroyés par Service correctionnel du Canada. Parmi ces mandats, la présente étude a comme objectif de caractériser les sols sous la dalle afin de formuler des hypothèses concernant la ou les cause(s) probable(s), d'un point de vue géotechnique, de l'affaissement de cette dernière, d'évaluer la stabilité à long terme de l'ouvrage et de donner des pistes de solutions afin de corriger la situation.

7.3 Capacité portante

Pour déterminer l'origine des mouvements de la dalle, la première étape consiste à déterminer la capacité portante qu'offrent les sols naturels en place, soit les sols argileux.

Pour ce faire, celle-ci a été calculée conformément aux prescriptions du Code national du Bâtiment (CNB), édition 2005. Ce code exige que le calcul des capacités portantes soit réalisé selon la méthode aux états limites. Les états limites calculés dans le cadre de ce projet sont les suivants :

- résistance géotechnique à l'état limite ultime (ÉLUL);
- résistance géotechnique à l'état limite d'utilisation (ÉLUT).

La résistance géotechnique à l'ÉLUL porte sur la sécurité, i.e., principalement sur les mécanismes de rupture de la structure. Elle correspond aux charges totales. La résistance géotechnique à l'ÉLUT se rapporte à l'usage prévu de la structure et concerne par exemple, les tassements totaux et différentiels. Elle correspond aux contraintes pouvant être ajoutées aux contraintes en place au niveau considéré dans le sol (charges nettes admissibles).

7.3.1 Résistance géotechnique à l'ÉLUL

La capacité portante à l'ultime (q_u) est évaluée à partir de l'équation tirée du *Canadian Foundation Engineering Manual - 2006, 4th edition* (C.F.E.M.) qui est la suivante :

$$q_u = c' N_c S_c I_c + q' N_q S_q I_q + 0,5 \gamma' B N_\gamma S_\gamma I_\gamma$$

Notons que lorsque les sols sous la fondation sont de nature argileuse, c'est-à-dire avec cohésion, et en conditions non drainées ($\phi' = 0^\circ$), le terme de poids du sol dans l'équation peut être négligé, ce qui est le présent cas.

- N_c , N_q et N_γ sont des coefficients de portance déterminés en fonction de l'angle effectif de frottement interne des sols.
- S_c , S_q et S_γ sont des coefficients de forme qui permettent de tenir compte de la géométrie de la fondation.
- I_c , I_q et I_γ sont des coefficients d'inclinaison qui permettent de tenir compte de l'inclinaison de charge.

Les valeurs des différents coefficients ci-dessus sont tirées du C.F.E.M. Le tableau No 5 résume les paramètres géotechniques à utiliser pour les fins du calcul de la résistance géotechnique à l'état limite ultime (ÉLUL). Basé sur les informations collectées dans les forages, ces paramètres sont valides pour des fondations conventionnelles prenant appui à partir du dépôt naturel d'argile silteuse. Dans ce calcul, compte tenu de la grande superficie de la dalle, nous ne tenons pas compte du coussin de pierre nette et des remblais rencontrés directement sous la dalle.

Tableau No 5 : Paramètres pour le calcul de l'ÉLUL

Paramètres	Valeur pour le dépôt d'argile silteuse
Cohésion effective (c')	20 kPa
Pression effective des terres au niveau de la dalle (q')	0 kPa
Profondeur d'encastrement de la dalle	0 m
Angle effectif de frottement interne (ϕ')	0°
Poids volumique effectif (γ')	6,0 kN/m ³
Poids volumique humide (γ)	16,0 kN/m ³
Coefficient de portance pour la cohésion (N_c)	5,1
Coefficient de portance pour la portance des terres (N_q)	1
Coefficient de portance pour le poids du sol (N_γ)	0

Selon les exigences du *Code national du Bâtiment* (CNB), édition 2005, pour des fondations superficielles, un coefficient de résistance de 0,5 devrait être appliqué à la valeur de la résistance géotechnique à l'état limite ultime (ÉLUL) pour obtenir la résistance géotechnique pondérée à l'état limite ultime pondéré.

À titre indicatif seulement, pour le Bloc « U », en considérant une profondeur d'encastrement nul et une dimension de 51,5 m par 122,9 m, on obtient une valeur d'ÉLUL de 110 kPa pour la dalle prenant appui à partir du dépôt d'argile silteuse. En appliquant le coefficient de résistance de 0,5 à la valeur d'ÉLUL, on obtient une valeur d'ÉLUL pondéré de 55 kPa.

Pour les besoins uniques de l'étude, les valeurs présentées considèrent une inclinaison de la charge égale à 1. L'effet de l'inclinaison des charges, le cas échéant, et l'excentricité qui en découle devront faire l'objet d'une analyse distincte pour toute autre situation en dehors de cette étude.

7.3.2 Résistance géotechnique à l'ÉLUT

Le tableau No 6 présente la résistance géotechnique à l'ÉLUT selon les informations collectées sur le terrain, c'est-à-dire pour une dimension de la dalle sur sol de 51,5 m par 122,9 m, une profondeur d'encastrement D nul et pour des tassements totaux inférieurs à 25 mm.

Tableau No 6 : Résistance géotechnique à l'ÉLUT pour fondations conventionnelles

Conditions	Résistance géotechnique à l'ÉLUT (kPa) pour la dalle sur sol
Résistance à l'état limite d'utilisation (ÉLUT) pour des tassements totaux inférieurs à 25 mm et un encastrement nul.	30

Rappelons que l'ÉLUT correspond aux contraintes pouvant être ajoutées aux contraintes en place au niveau considéré dans le sol (charges nettes admissibles).

Enfin, il est à noter que la charge induite sur la dalle n'est pas incluse dans les valeurs précitées. Il en va de même pour tout rehaussement éventuel du niveau actuel des sols.

7.4 Cause(s) probable(s) des tassements

7.4.1 Hétérogénéité des remblais sous la dalle sur sol

Selon les données de forage, la dalle sur sol est fondée sur un coussin de pierre concassée d'épaisseur très variable (0,41 à 1,03 mètre) reposant sur des remblais de composition variable : 1) sable, silt et gravier en proportions variables (F-1, F-5 et F-6) ; 2) argile silteuse (F-3) et ; 3) présence combinée des couches 1 et 2 (F-2 et F-4). Selon les indices « N » mesurés au sein de ces remblais à l'essai de pénétration standard, la compacité des remblais est variable et est qualifiée de *lâche* à *très dense* (N de 4 à 51 coups/30 cm).

Des conditions semblables sont propices à produire des tassements différentiels au niveau de la dalle sur sol. Rappelons également que sous la dalle, des vides ont été notées entre la dalle et le remblai dans les forages F-1 (35 mm), F-3 (32 mm), F-5 (25 mm) et F-6 (10 mm).

7.4.2 Consolidation de l'argile

Selon les informations disponibles, la dalle du bâtiment aurait été construite il y a environ une quarantaine d'années. Quant aux dommages, ceux-ci ont été observés que récemment. Selon les données de forage, le bâtiment est fondé sur un important dépôt d'argile compressible. Il est connu que les tassements dus à la consolidation de l'argile, sont des tassements qui se produisent à long terme. Selon toute évidence, les dommages divers observés et les mouvements de la dalle sur sol du Bloc « U » pourraient être attribuables au tassement du dépôt argileux.

En effet, au droit des forages, un horizon d'argile de consistance *molle* et faiblement surconsolidée a été intercepté entre 4 et 7 m de profondeur. Également, selon les résultats de l'essai de consolidation oedométrique réalisé sur l'argile silteuse *ferme*, cette dernière est surconsolidée de 72 kPa à 3,47 m de profondeur. Cette valeur calculée de surconsolidation correspond à la contrainte résiduelle maximale théorique pouvant être ajoutée à la contrainte effective des sols en place calculée à ce niveau, et ce, pour demeurer dans le domaine surconsolidé de l'argile. Ainsi, lorsque les contraintes totales (poids des sols, charges mortes et vives, etc.) transmises à l'argile excèdent la pression de préconsolidation, d'importants tassements sont à anticiper. À ce propos, il y aurait tout lieu de vérifier que les contraintes totales transmises au dépôt d'argile n'excèdent pas les résistances géotechniques de ce dernier.

À la lumière des données disponibles, il n'est pas possible de statuer sur la stabilité à long terme de l'ouvrage dans les conditions actuelles, à savoir si les mouvements vont ou non se poursuivre dans le temps. La mesure et le suivi dans le temps des pressions interstitielles au sein du dépôt argileux permettraient de vérifier la présence de surpressions. Des surpressions dans ce type de dépôt peuvent notamment résulter de contraintes qui ne sont pas totalement dissipées et indiquer par conséquent que des tassements sont à anticiper dans le temps.

7.4.3 Modification(s) à l'environnement

Un abaissement permanent du niveau de la nappe d'eau souterraine, occasionné entre autre par des modifications apportées à l'environnement, peut également avoir contribué à surcharger le dépôt d'argile. À titre indicatif seulement, un abaissement permanent de la nappe d'eau souterraine d'un (1) mètre induit une surcharge de 10 kPa.

Une augmentation des charges appliquées (vives et/ou mortes) sur la dalle sur sol, entre autres, par des modifications apportées aux cloisons intérieures, aux équipements en place, aux activités se déroulant dans l'enceinte, etc., peuvent également avoir contribué à surcharger l'argile.

7.5 Éléments de solution

Cette section présentée différentes pistes de solution permettant de corriger la situation et/ou de limiter les tassements des sols argileux.

Les solutions proposées permettent de stabiliser la dalle sur sol et/ou les sols sous l'aire de la dalle. Une combinaison de plusieurs solutions proposées peut aussi être retenue par le concepteur. Toutefois, avant de sélectionner une ou des solutions, il est recommandé dans un premier temps, qu'une évaluation des charges transmises au sol par la dalle sur sol soit réalisée par un ingénieur en structure du bâtiment.

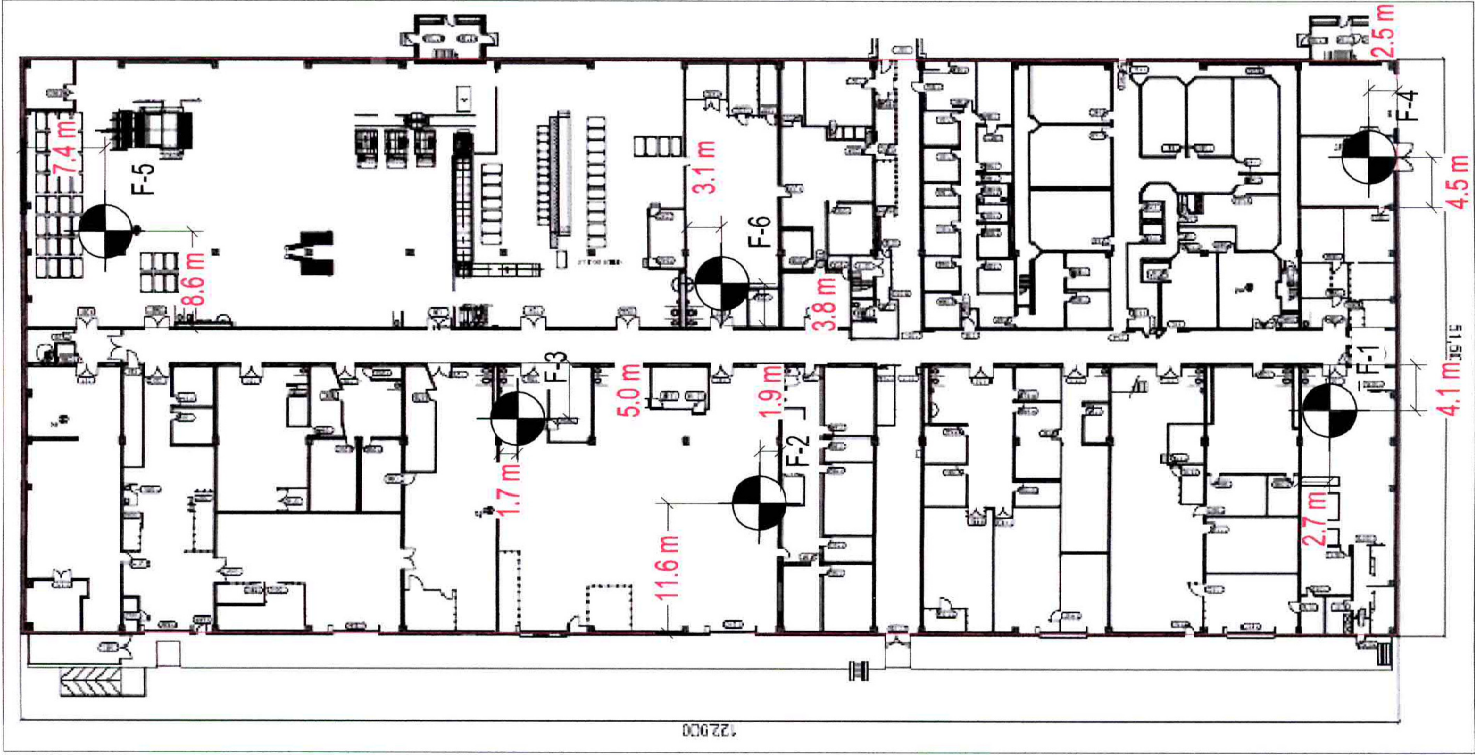
7.5.1 Dalle structurale sur fondations profondes

Afin de limiter les tassements induits par les charges transmises au sol par la dalle, ces dernières pourraient être reprises-en sous-œuvre par une dalle structurale dérivant sa portance à partir de pieux battus au refus. Cette solution permettrait, sous la dalle, de stabiliser les sols et par conséquent de limiter les tassements des remblais et des sols argileux probablement responsables des mouvements observés sur la dalle sur sol. Une évaluation structurale devra être réalisée pour déterminer s'il est possible d'utiliser les fondations profondes existantes ou si de nouveaux pieux doivent-être mis en place.

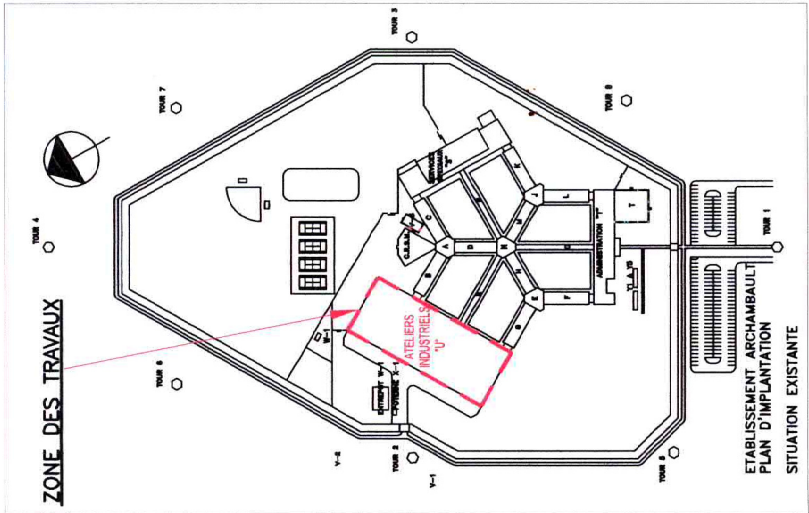
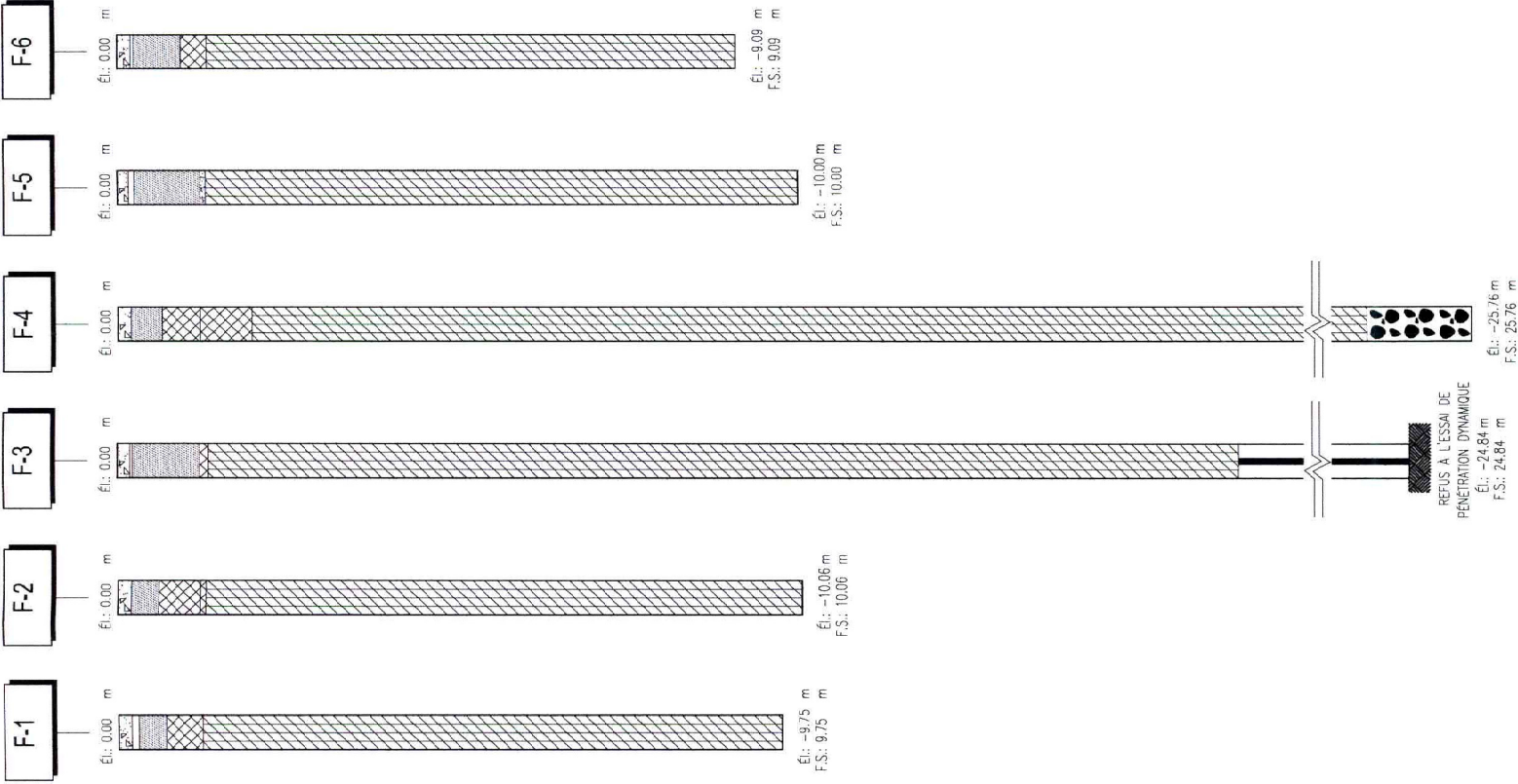
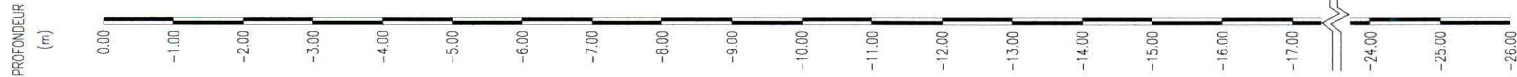
7.5.2 Limiter la charge

Cette solution, qui se veut être la plus simple techniquement, consiste à limiter les charges transmises au sol de manière à ce qu'elles n'excèdent pas les résistances géotechniques du dépôt d'argile. Cette solution implique, entre autres, de limiter les charges sur la dalle sur sol de manière à ce que les charges totales (dalle, cloisons intérieures, équipement, entreposage, etc.) transmises demeurent inférieures à la capacité portante déterminée à la section 7.3. Il est à noter que cette solution seule ne permet pas de corriger la dalle actuelle et d'assurer en tous points la stabilité à long terme de cette dernière.

**Annexe A –
Croquis de localisation et aperçu stratigraphique -
SCCG1-00011433-00-55-00-1/1**



DÉTAILS, ATELIER INDUSTRIEL «U»



PLAN CLÉ

- LÉGENDE
- DALLE DE BÉTON DE CIMENT
 - VIDE SOUS LA DALLE
 - PIERRE CONCASSÉE
 - REMBLAI
 - ARGILE SAUTEUSE
 - BLOC ET/OU CALLOUX ET GRAVIER
 - ESSAI DE PÉNÉTRATION DYNAMIQUE
 - FORAGE
 - F.S. FIN DE SONDAGE

Les Services exp Inc.



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NOTES

- (1) CE DESSIN DOIT ÊTRE LU AVEC LE RAPPORT SCCG1-00011433-00-55-00-00-R01 QU'IL ACCOMPAGNE
- (2) PLAN TIRÉ DES FICHIERS ÉLECTRONIQUES #341-SITE-SCHMADWIG-F01URNI PAR LE SERVICE CORRECTIONNEL DU CANADA/LA MAQUA
- (3) FOND DE PLAN ANNEXE A PLAN DU BLOC U PLAN-PDF FOURNI PAR LE SERVICE CORRECTIONNEL DU CANADA/LAVAL

Client : SERVICE CORRECTIONNEL DU CANADA			
Projet : ÉTUDE GÉOTECHNIQUE - AFFAISEMENT DE LA DALLE DU BLOC « U » - ÉTABLISSEMENT ARCHAMBAULT À SAINTE-ANNE-DES-PLAINES			
Titre : LOCALISATION DES SONDAGES ET APERÇU STRATIGRAPHIQUE			
Approuvé par : A. Proulx, ing.	Dossier no : SCCG1-00011433-00-55-00	Date : 27 JUN 2011	Plan : L01
Dessiné par : I. Frigon	Fichier électronique : SCCG-1-00011433-00-55-00.dwg	Échelle : N-A-E	Feuillet no : 1/1

Annexe B –

**Notre explicative et Généralités et portée de l'étude
Rapports de forage (F1 à F6)**

DOSSIER No.: SCCG1-00011433

PAGE: 1 de 1

PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-1

ENDROIT: BLOC «U», ÉTABLISSEMENT ARCHAMBAULT

NIVEAU DE BASE:

TUBAGE: NW

MARTEAU: MASSE = 63.50 kg

CHUTE: 0.76 m

COORDONNÉES: LONGITUDE : ° _____ NORD : _____

DATE DU FORAGE: 2011-04-18

LATITUDE : ° _____ EST : _____

DATE DU RAPPORT: 2011-06-27

NIVEAU D'EAU: PROFONDEUR (m): _____

CF: CAROTTIER FENDU

FOREUR: Fora-Sol inc.

TM: TUBE MINCE

TECHNICIEN: A. Tremblay

ET: TARIÈRE

COMPILÉ PAR: S. Thibault

CR: CAROTTE DE CALIBRE : _____

VÉRIFIÉ PAR: A. Proulx

PROF.		COUPE STRATIGRAPHIQUE		EAU	ÉCHANTILLONS						ESSAIS	PÉNÉTRATION DYNAMIQUE ET RÉSISTANCE AU CISAILLEMENT	
PI.	M.	Élév. Prof. (m)	DESCRIPTION		ÉTAT	TYPE & NO.	RÉC. %	N / RQD	FAIBLE	MOYENNE	FORTE	Cu Cur Nc	▽ CHANTIER × Nc ▽ LABO ⊗ w
		0.00	Niveau actuel du sol										
		0.00	Dalle de béton de ciment: 185 mm d'épaisseur.			CR-1							
		-0.19	Vide sous la dalle; 35 mm.			CF-2	67	R					
		-0.23	Pierre concassée.			CF-3	58	51					
1		0.23	Remblai: Sable, un peu à traces de gravier, traces de silt; brun grisâtre foncé.			CF-4	46	11					
5		0.69				CF-5	38	6					
2		-1.24				CF-6	25	4					
10		1.24	Argile silteuse à un peu de silt, traces de sable; brun grisâtre. Présence d'oxydation. Consistance ferme à raide. Très sensible à extrêmement sensible au remaniement.			TM-7	96					w = 62% St = 12 Cu=44kPa	
4			Sous 3,7 m; devenant grise.			CF-8	100	0					
15			Entre 4,1 et 7,2 m: Consistance molle.			TM-9	100					w = 76% St = 24 Cu=17kPa	
5			Sous 5,2 m; présence de matières organiques noires.			CF-10	100	0					
20			Présence de coquillages entre 6,4 et 9,75 m.			TM-11	96					w = 78% St = 40 Cu=20kPa	
7						TM-12	91					w = 55% St = 292 Cu=58kPa	
25						TM-13	92					w = 69%	
8													
9													
30													
10		-9.75 9.75	Fin du forage à 9,75 mètres de profondeur.										

DOSSIER No.: SCCG1-00011433

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PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-2

ENDROIT: BLOC «U», ÉTABLISSEMENT ARCHAMBAULT

NIVEAU DE BASE: TUBAGE: NW

MARTEAU: MASSE = 63.50 kg CHUTE: 0.76 m

COORDONNÉES: LONGITUDE: ° NORD: °

DATE DU FORAGE: 2011-04-14

LATITUDE: ° EST: °

DATE DU RAPPORT: 2011-06-28

NIVEAU D'EAU: PROFONDEUR (m):

CF: CAROTTIER FENDU

FOREUR: Fora-Sol inc.

TM: TUBE MINCE

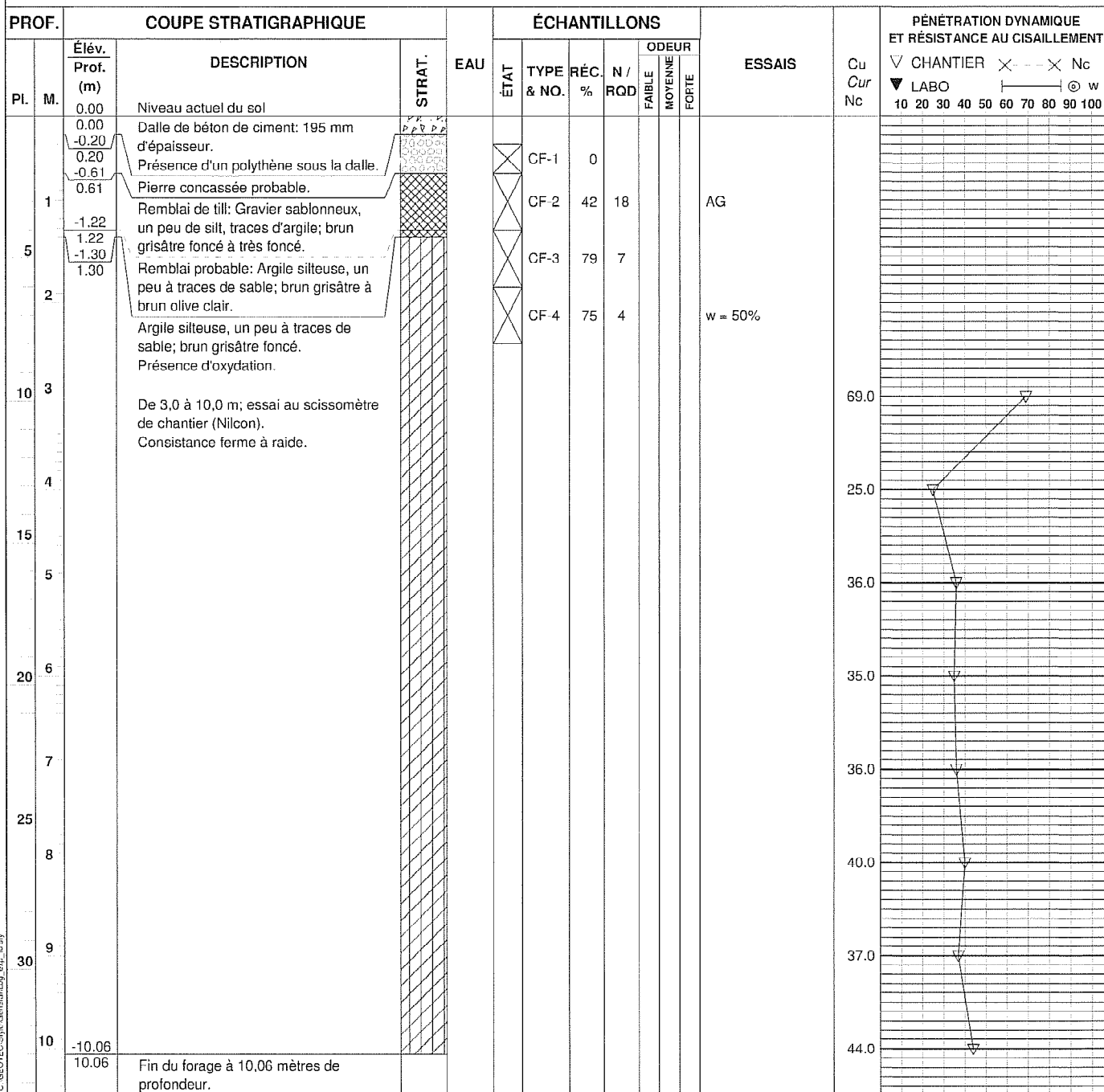
TECHNICIEN: A. Tremblay

ET: TARIÈRE

COMPILÉ PAR: S. Thibault

CR: CAROTTE DE CALIBRE: _____

VÉRIFIÉ PAR: A. Proulx



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PAGE: 1 de: 3

PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-3

ENDROIT: BLOC «U», ÉTABLISSEMENT ARCHAMBAULT

NIVEAU DE BASE:

TUBAGE: NW

MARTEAU: MASSE = 63.50 kg

CHUTE: 0.76 m

COORDONNÉES: LONGITUDE : ° NORD :

DATE DU FORAGE: 2011-04-13

LATITUDE : ° EST :

ÉCHANTILLONS

DATE DU RAPPORT: 2011-06-27

NIVEAU D'EAU: PROFONDEUR (m):

 CF: CAROTTIER FENDU

FOREUR: Fora-Sol inc.

DATE:

 TM: TUBE MINCE

TECHNICIEN: A. Tremblay

ET: TARIÈRE

COMPILÉ PAR: S. Thibault

☐ ☒ ☐ CR: CAROTTE DE CALIBRE : _____

VÉRIFIÉ PAR: A. Proulx

[illegible]



RAPPORT DE FORAGE

DOSSIER No.: SCCG1-00011433

PAGE: 2 de 3

PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-3

PROF.		COUPE STRATIGRAPHIQUE			EAU	ÉCHANTILLONS						ESSAIS	Cu Cur Nc	PÉNÉTRATION DYNAMIQUE ET RÉSISTANCE AU CISAILLEMENT																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Pl.	M.	Élèv. Prof. (m)	DESCRIPTION	STRAT.		ÉTAT	TYPE & NO.	RÉC. %	N / RQD	ODEUR				CHANTIER	LABO																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
										FABLE	MOYENNE				FORTE	10	20	30	40	50	60	70	80	90	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
	11		brun rougeâtre.			CF-13	100	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								</



RAPPORT DE FORAGE

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PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-3

PROF.		COUPE STRATIGRAPHIQUE			EAU	ÉCHANTILLONS						ESSAIS	PÉNÉTRATION DYNAMIQUE ET RÉSISTANCE AU CISAILLEMENT	
Pl.	M.	Élèv. Prof. (m)	DESCRIPTION	STRAT.		ÉTAT	TYPE & NO.	RÉC. %	N / RQD	ODEUR				
										FAIBLE	MOYENNE	FORTE		
80													Cu Cur Nc	▽ CHANTIER × × Nc ▼ LABO ⊗ w 10 20 30 40 50 60 70 80 90 100
													53.0	
													46.0	
													100.0	
25		-24.84 24.84	Fin du forage à 24,84 mètres de profondeur sur un refus à l'essai de pénétration dynamique.											
85														
26														
27														
90														
28														
95														
29														
30														
100														
31														
105														
32														
33														
110														
34														
115														
35														
36														
120														
37														

DOSSIER No.: SCCG1-00011433

PAGE: 1 de 3

PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-4

ENDROIT: BLOC «U», ÉTABLISSEMENT ARCHAMBAULT

NIVEAU DE BASE:

TUBAGE: NW

MARTEAU: MASSE = 63.50 kg

CHUTE: 0.76 m

COORDONNÉES: LONGITUDE: ° NORD: °

DATE DU FORAGE: 2011-04-19

LATITUDE: ° EST: °

DATE DU RAPPORT: 2011-06-27

NIVEAU D'EAU: PROFONDEUR (m):

ÉCHANTILLONS

FOREUR: Fora-Sol inc.

DATE:

TECHNICIEN: A. Tremblay

CF: CAROTTIER FENDU

COMPILÉ PAR: S. Thibault

TM: TUBE MINCE

VÉRIFIÉ PAR: A. Proulx

ET: TARIÈRE

CR: CAROTTE DE CALIBRE: NQ

PROF.		COUPE STRATIGRAPHIQUE			ÉCHANTILLONS							ESSAIS		PÉNÉTRATION DYNAMIQUE ET RÉSISTANCE AU CISAILEMENT	
PI.	M.	Élev. Prof. (m)	DESCRIPTION	STRAT.	EAU	ÉTAT	TYPE & NO.	RÉC. %	N / ROD	FAIBLE	MOYENNE	FORTE		Cu Cur Nc	▽ CHANTIER ▽ LABO
		0.00	Niveau actuel du sol												
		-0.20	Dalle de béton de ciment: 200 mm d'épaisseur.				CR-1								
		0.20	Pierre concassée.				CF-2	31	R						
1		-0.66	Remblai: Argile silteuse, un peu à traces de sable; gris foncé à brun grisâtre.				CF-3	42	4						
5		-1.22	Présence d'oxydation.				CF-4	42	14						
2		-1.98	Remblai hétérogène: Mélange de gravier de sable et d'argile; brun grisâtre et brun olive.				CF-5	100	6						
		1.98	Argile silteuse, traces de sable; brun grisâtre.												
10	3		De 3.0 à 10.0 m : essai au scissomètre de chantier (Nilcon). Consistance ferme à raide.												
	4														
15	5														
	6														
20	7														
	8														
25	9														
30	10														



RAPPORT DE FORAGE

DOSSIER No.: SCCG1-00011433

PAGE: 2 de 3

PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-4

PROF.		COUPE STRATIGRAPHIQUE			EAU	ÉCHANTILLONS							ESSAIS	Cu Cur Nc	PÉNÉTRATION DYNAMIQUE ET RÉSISTANCE AU CISAILLEMENT																		
Pl.	M.	Élev. Prof. (m)	DESCRIPTION	STRAT.		ÉTAT	TYPE & NO.	RÉC. %	N / RQD	ODEUR					▽ CHANTIER	✕	✕	Nc	▼ LABO		⊙	w	10	20	30	40	50	60	70	80	90	100	
										FAIBLE	MOYENNE	FORTE																					
	11																																
	12																																
40																																	
	13																																
45																																	
	14																																
50																																	
	16																																
55																																	
	17																																
	18																																
60																																	
	19																																
65																																	
	20																																
	21																																
70			Sous 21,3 m; devenant gris foncé.			✕	CF-6	83	0																								
	22																																
75																																	
	23																																



RAPPORT DE FORAGE

DOSSIER No.: SCCG1-00011433

PAGE: 3 de 3

PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-4

PROF.		COUPE STRATIGRAPHIQUE				EAU	ÉCHANTILLONS						ESSAIS	Cu Cur Nc	PÉNÉTRATION DYNAMIQUE ET RÉSISTANCE AU CISAILLEMENT																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Pl.	M.	Élèv. Prof. (m)	DESCRIPTION	STRAT.	ÉTAT		TYPE & NO.	RÉC. %	N / RQD	ODEUR					▽ CHANTIER	×	×	Nc	▽ LABO		⊗ w																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
										FAIBLE	MOYENNE	FORTE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
80		-24.23 24.23	Bloc et/ou cailloux et gravier.			CR-7	43																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								

DOSSIER No.: SCCG1-00011433

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PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-5

ENDROIT: BLOC «U», ÉTABLISSEMENT ARCHAMBAULT

NIVEAU DE BASE:

TUBAGE: NW

MARTEAU: MASSE = 63.50 kg

CHUTE: 0.76 m

COORDONNÉES: LONGITUDE : ° NORD :

DATE DU FORAGE: 2011-04-18

LATITUDE : ° EST :

DATE DU RAPPORT: 2011-06-27

NIVEAU D'EAU: PROFONDEUR (m):

CF: CAROTTIER FENDU

FOREUR: Fora-Sol inc.

DATE:

TM: TUBE MINCE

TECHNICIEN: A. Tremblay

ET: TARIÈRE

COMPILÉ PAR: S. Thibault

CR: CAROTTE DE CALIBRE :

VÉRIFIÉ PAR: A. Proulx

ÉCHANTILLONS

PROF.		COUPE STRATIGRAPHIQUE				ÉCHANTILLONS							PÉNÉTRATION DYNAMIQUE ET RÉSISTANCE AU CISAILLEMENT				
Pl.	M.	Élèv. Prof. (m)	DESCRIPTION	STRAT.	EAU	ÉTAT	TYPE & NO.	RÉC. %	N / RQD	ODEUR			ESSAIS	Cu Cur Nc	PÉNÉTRATION DYNAMIQUE ET RÉSISTANCE AU CISAILLEMENT		
										FAIBLE	MOYENNE	FORTE			▽ CHANTIER	× Nc	
		0.00	Niveau actuel du sol												▽ LABO	⊗ w	
		-0.17	Dalle de béton de ciment: 165 mm d'épaisseur.			■	CR-1						CF-2 et CF-3: AG				
		0.17	Vide sous la dalle: 25 mm.			△	CF-2	50	R								
		-0.19	Pierre concassée.			△	CF-3	33	32								
		0.19				△											
		-1.22				△											
	5	1.22	Sable silteux à un peu de silt, traces de gravier, traces d'argile; brun olive clair.			△	CF-4	75	7								
		-1.30				△											
		1.30	Présence d'oxydation.			△	CF-5	83	2								
	2		Argile silteuse, un peu à traces de sable; brun grisâtre. Présence d'oxydation.			△											
	10	3	De 3,0 à 10,0 m: essais au scissomètre de chantier (Nilcon). Consistance ferme.											47.0			
		4												29.0			
	15	5												34.0			
		6												35.0			
	20													34.0			
		7												42.0			
	25	8												39.0			
		9												46.0			
	30																
	10	-10.00	Fin du forage à 10,0 mètres de profondeur.														
		10.00															

RAPPORT DE FORAGE

DOSSIER No.: SCCG1-00011433

PAGE: 1 de: 1

PROJET: AFFAISSEMENT DE LA DALLE SUR SOL

FORAGE: F-6

ENDROIT: BLOC «U», ÉTABLISSEMENT ARCHAMBAULT

NIVEAU DE BASE: TUBAGE: NW

MARTEAU: MASSE = 63.50 kg

COORDONNÉES: LONGITUDE : ° NORD :

DATE DU FORAGE: 2011-04-14

LATITUDE : ° EST :

DATE DU RAPPORT: 2011-06-28

NIVEAU D'EAU: PROFONDEUR (m):

FOREUR: Fors-Sol inc.

DATE:

TECHNICIEN: A. Tremblay

COMPIÉ PAR: S. Thibault

VÉRIFIÉ PAR: A. Proulx

ÉCHANTILLONS

 CF: CAROTTIER FENDU

 TM: TUBE MINCE

ET: TARIÈRE

 CR: CAROTTE DE CALIBRE : _____

[illegible]

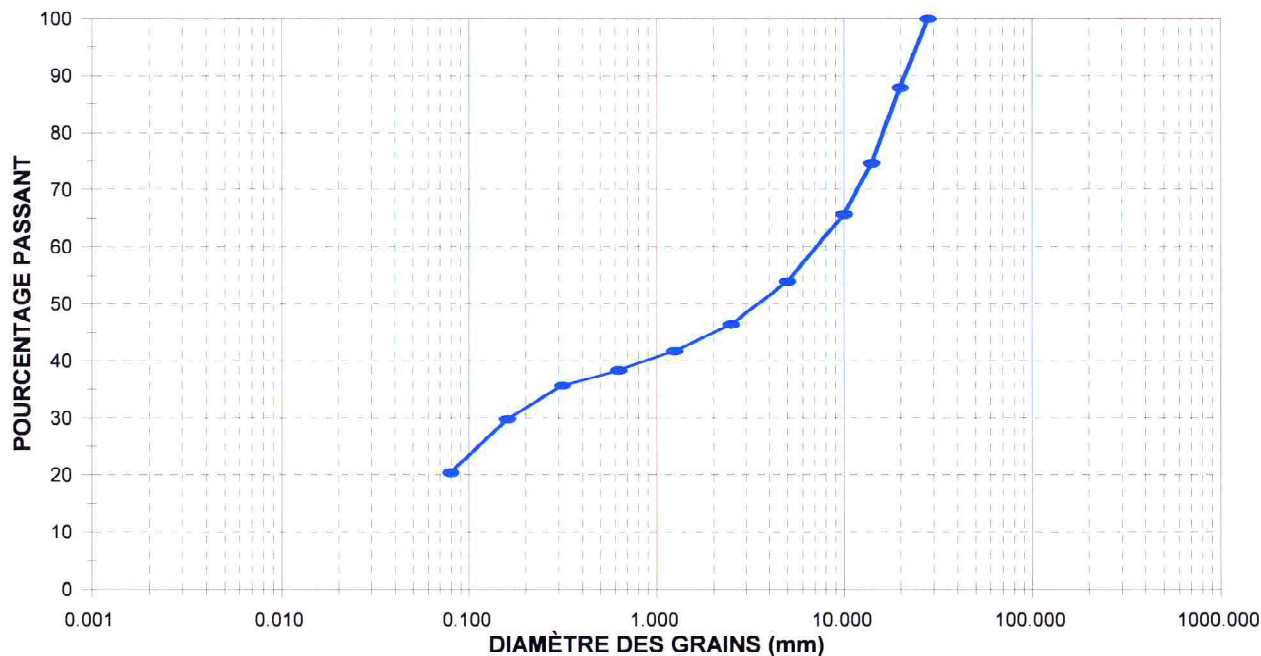
Annexe C – Résultats d’essais de laboratoire

Sondage: **F-2**
Échantillon: **CF-2**
Profondeur: **de 0,61 à 1,22 m**

Dossier No.: **SCCG1-00011433-00-55-00**
No. lab.: **LAG-0018**

Exigences: Non-applicable

COURBE GRANULOMÉTRIQUE



ARGILE ET SILT	fin	moyen	gros	fin	gros	CAILLOUX	BLOCS
	SABLE			GRAVIER			

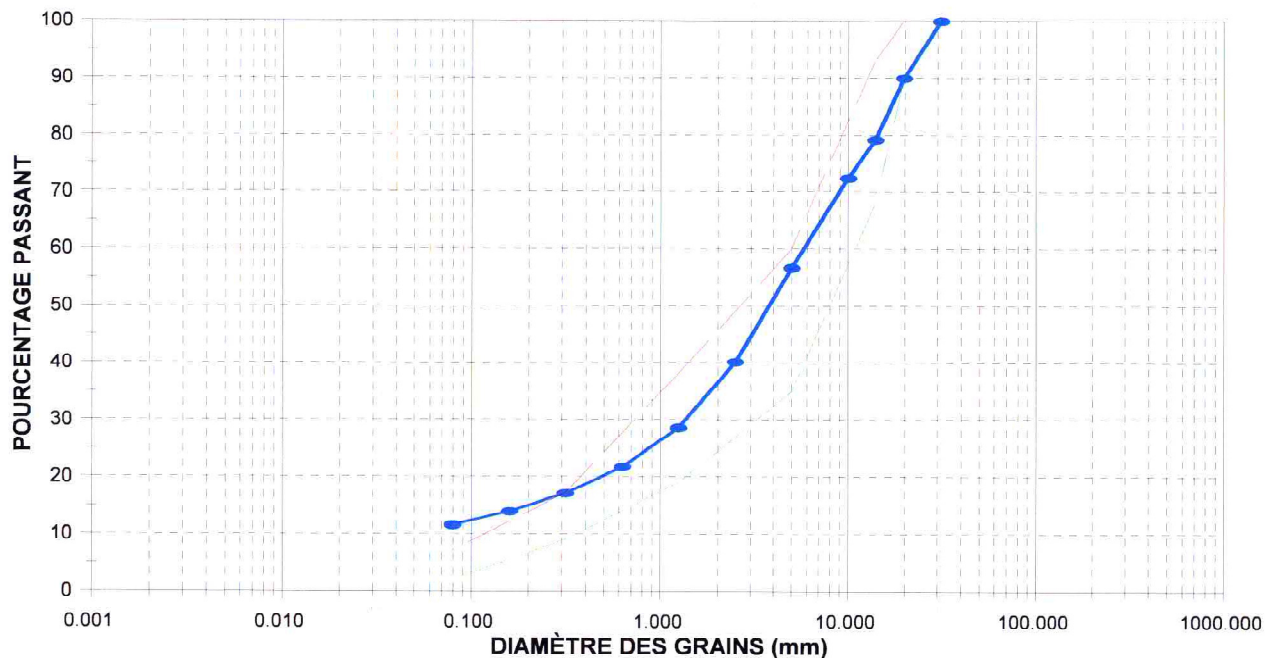
TAMIS (mm)	TAMISAT (%passant)		DESCRIPTION	REMARQUES
	exigences	mesuré		
150			Matériau: Gravier sablonneux, un peu de silt, traces d'argile	
125				
112			D10: N/D mm D30: N/D mm D60: N/D mm	
80				
56			Coefficient d'uniformité (Cu): N/D Coefficient de courbure (Cc): N/D Module de finesse (m.f.): N/D	
40				
28		100	Gravier: 46 % Sable: 34 % Silt et argile: 20 %	
20		88		
14		75	Classification unifiée: N/D	
10		66		
5		54		
2.5		46		
1.250		42		
0.630		38		
0.315		36		
0.160		30		
0.080		20.3		
Note: * Déficience granulométrique			Ce rapport ne peut être reproduit, sinon en entier, sans l'autorisation écrite de exp. À moins d'avis contraire, les résultats ne s'appliquent qu'à l'échantillon analysé.	
			Analysé par: A.V. Date: 3 mai 2011 Vérifié par: S. Gingras, T.P. Date: 4 mai 2011	

Sondage: **F-3**
Échantillon: **CF-1**
Profondeur: **de 0,23 à 0,61 m**

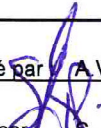
Dossier No.: **SCCG1-00011433-00-55-00**
No. lab.: **LAG-0018**

Exigences: **MG 20 (NQ 2560-114)**

COURBE GRANULOMÉTRIQUE



ARGILE ET SILT	fin	moyen	gros	fin	gros	CAILLOUX	BLOCS
	SABLE			GRAVIER			

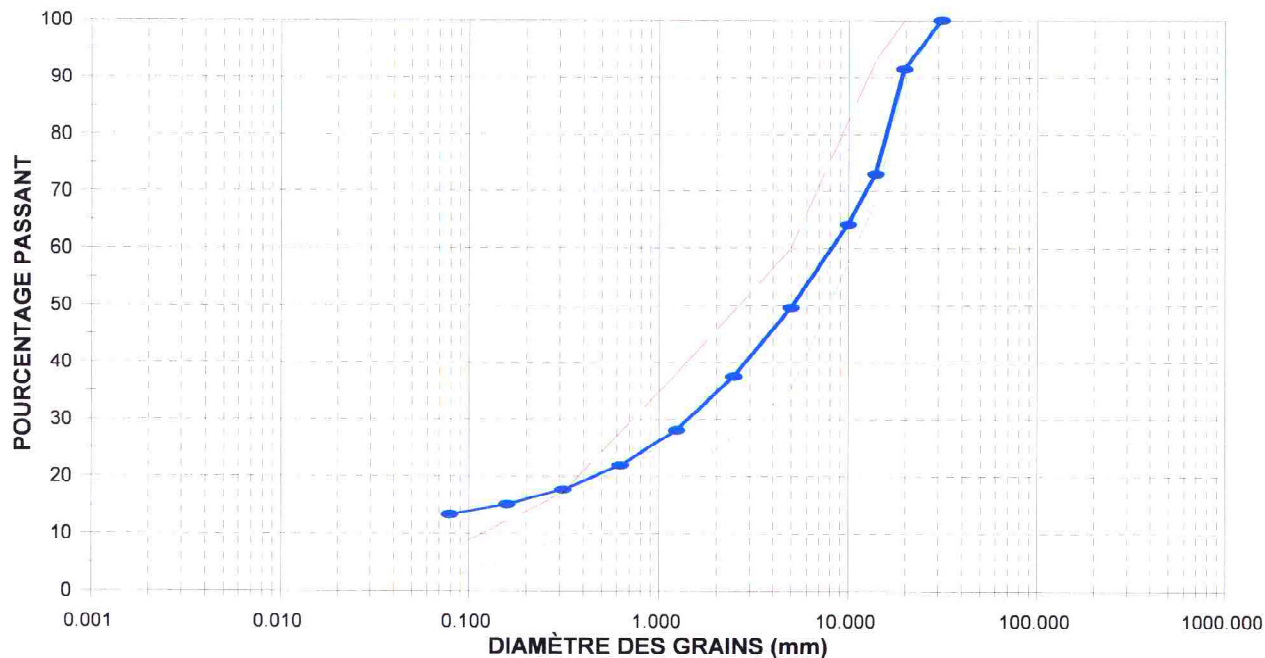
TAMIS (mm)	TAMISAT (%passant)		DESCRIPTION	REMARQUES	
	exigences	mesuré			
150			Matériau: Sable et gravier, un peu de silt		
125					
112			D10: N/D mm		
80			D30: N/D mm		
56			D60: N/D mm		
40			Coefficient d'uniformité (Cu): N/D		
31.5	100	100	Coefficient de courbure (Cc): N/D		
20	90-100	90	Module de finesse (m.f.): N/D		
14	68-93	79			
10		72			
5	35-60	57	Gravier: 43 %		
2.5		40	Sable: 45 %		
1.250	19-38	29	Silt et argile: 12 %		
0.630		22			
0.315	9-17	17	Classification unifiée: N/D		
0.160		14			
0.080	2,0-7,0	11.5 *			
Note:			Ce rapport ne peut être reproduit, sinon en entier, sans l'autorisation écrite de exp. À moins d'avis contraire, les résultats ne s'appliquent qu'à l'échantillon analysé.		
* Déficience granulométrique			Analyisé par  A.V. Date: 2 mai 2011 Vérifié par S. Gingras, T.P. Date: 4 mai 2011		

Sondage: **F-5**
Échantillon: **CF-2 + CF-3**
Profondeur: **de 0,20 à 1,22 m**

Dossier No.: **SCCG1-00011433-00-55-00**
No. lab.: **LAG-0018**

Exigences: **MG 20 (NQ 2560-114)**

COURBE GRANULOMÉTRIQUE



ARGILE ET SILT	fin	moyen	gros	fin	gros	CAILLIUX	BLOCS
	SABLE			GRAVIER			

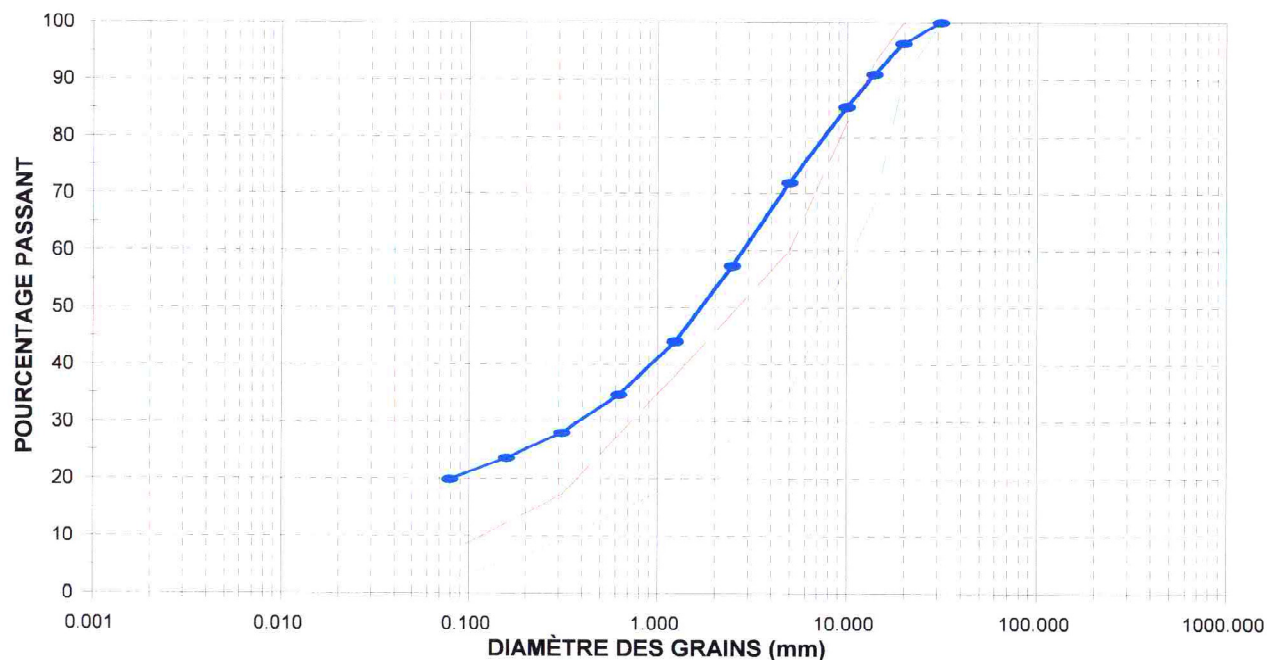
TAMIS (mm)	TAMISAT (%passant)		DESCRIPTION	REMARQUES
	exigences	mesuré		
150			Matériau: Gravier et sable, un peu de silt	
125				
112			D10: N/D mm D30: N/D mm D60: N/D mm	
80				
56			Coefficient d'uniformité (Cu): N/D Coefficient de courbure (Cc): N/D Module de finesse (m.f.): N/D	
40				
31.5	100	100	Gravier: 51 % Sable: 36 % Silt et argile: 13 %	
20	90-100	91		
14	68-93	73	Classification unifiée: N/D	
10		64		
5	35-60	49		
2.5		37		
1.250	19-38	28		
0.630		22		
0.315	9-17	18		
0.160		15		
0.080	2,0-7,0	13.2		
Note: * Déficience granulométrique			Ce rapport ne peut être reproduit, sinon en entier, sans l'autorisation écrite de exp. À moins d'avis contraire, les résultats ne s'appliquent qu'à l'échantillon analysé.	Analysé par : A.V. & F.N. Date: 2 mai 2011 Vérifié par : S. Gingras, T.P. Date: 4 mai 2011

Sondage: **F-6**
Échantillon: **CF-1**
Profondeur: **de 0,20 à 0,61 m**

Dossier No.: **SCCG1-00011433-00-55-00**
No. lab.: **LAG-0018**

Exigences: **MG 20 (NQ 2560-114)**

COURBE GRANULOMÉTRIQUE



ARGILE ET SILT	fin	moyen	gros	fin	gros	CAILLOUX	BLOCS
	SABLE			GRAVIER			

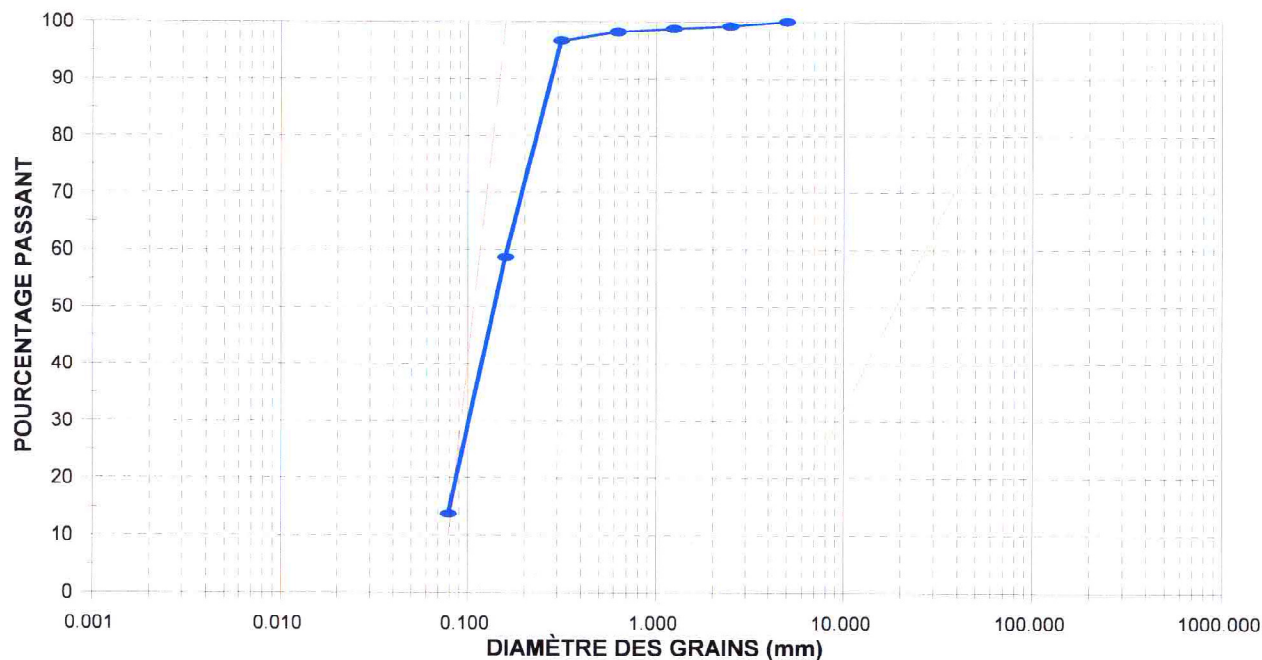
TAMIS (mm)	TAMISAT (%passant)		DESCRIPTION	REMARQUES	
	exigences	mesuré			
150			Matériau: Sable graveleux silteux		
125					
112			D10: N/D mm		
80			D30: N/D mm		
56			D60: N/D mm		
40			Coefficient d'uniformité (Cu): N/D		
31.5	100	100	Coefficient de courbure (Cc): N/D		
20	90-100	96	Module de finesse (m.f.): N/D		
14	68-93	91			
10		85			
5	35-60	72	Gravier: 28 %		
2.5		57	Sable: 52 %		
1.250	19-38	44	Silt et argile: 20 %		
0.630		35			
0.315	9-17	28	Classification unifiée: N/D		
0.160		24			
0.080	2,0-7,0	19.7			
Note: * Déficience granulométrique			Ce rapport ne peut être reproduit, sinon en entier, sans l'autorisation écrite de exp. À moins d'avis contraire, les résultats ne s'appliquent qu'à l'échantillon analysé.		
			Analyisé par : A.V. & F.N. Date: 2 mai 2011		
			Vérifié par : S. Gingras, T.P. Date: 4 mai 2011		

Sondage: **F-6**
Échantillon: **CF-2 (3 de 3)**
Profondeur: **de 0,94 à 1,22 m**

Dossier No.: **SCCG1-00011433-00-55-00**
No. lab.: **LAG-0018**

Exigences: **MG 112 (NQ 2560-114)**

COURBE GRANULOMÉTRIQUE



ARGILE ET SILT	fin	moyen	gros	fin	gros	CAILLLOUX	BLOCS
	SABLE			GRAVIER			

TAMIS (mm)	TAMISAT (%passant)		DESCRIPTION	REMARQUES
	exigences	mesuré		
150	100		Matériau: Sable, un peu de silt	
125				
112				
80				
56				
40				
31.5				
20				
14				
10				
5	12-100	100	D10: N/D mm D30: N/D mm D60: N/D mm Coefficient d'uniformité (Cu): N/D Coefficient de courbure (Cc): N/D Module de finesse (m.f.): N/D	
2.5				
1.250				
0.630				
0.315				
0.160	0,0-10,0	59	Gravier: 0 % Sable: 86 % Silt et argile: 14 %	
0.080				
		13.6	Classification unifiée: N/D	
Note:			Ce rapport ne peut être reproduit, sinon en entier, sans l'autorisation écrite de exp. À moins d'avis contraire, les résultats ne s'appliquent qu'à l'échantillon analysé.	
* Déficience granulométrique			Analyse par : A.V. & F.N. Date: 2 mai 2011 Vérifié par : S. Gingras, T.P. Date: 4 mai 2011	

Note:

* Déficience granulométrique



ESSAI DE CONSOLIDATION

(ASTM - D2435)

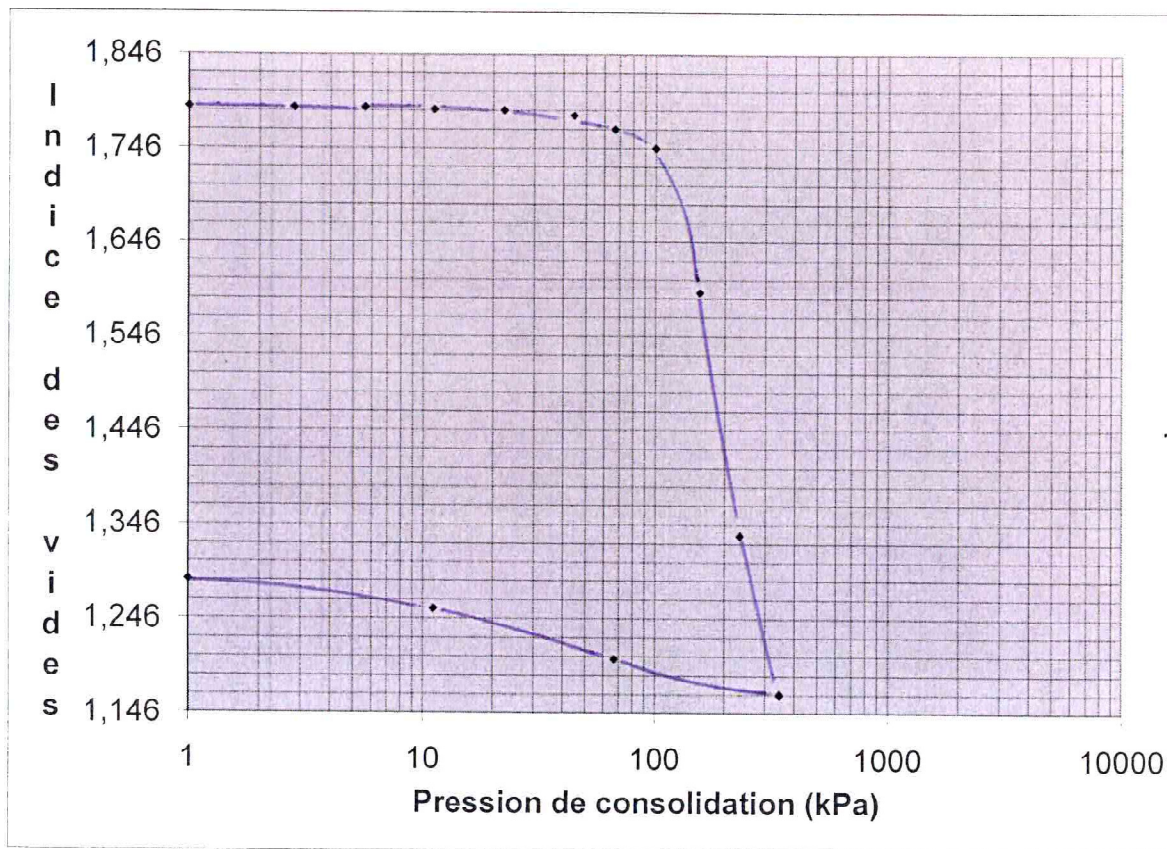
Dossier No : 11433

Sondage No : F-3

No Laboratoire : 9927GJ

Échantillon No : TM-6

Projet : SCCGI-00011433 : SERVICE CORRECTIONNEL DU CANADA, STE-A Profondeur : 3,47 m



CARACTÉRISTIQUES DE L'ÉCHANTILLON

		ÉTAT INITIAL	ÉTAT FINAL
Teneur en eau (%)		67,1	49,8
Poids volumique humide (kN/m ³)		16,0	17,5
Poids volumique sec (kN/m ³)		9,6	11,7
Degré de saturation (%)		102,0	105,2
Indice des vides		1,79	1,29

CARACTÉRISTIQUES DE L'APPAREIL

Oedomètre No	2	Anneau No	1
Modèle	24001	Diamètre (cm)	4,99
Série	1779	Hauteur (cm)	1,91

RÉSULTATS MESURÉS

Contrainte effective verticale initiale en place	(kPa)	39*
Pression de préconsolidation	(kPa)	133
" " " minimale	(kPa)	122
" " " maximale	(kPa)	139
Indice de compression	(Cc)	1,36
Indice de recompression	(Cr)	0,01
*Nappe d'eau considérée à	(m)	1,2

TAUX DE CHARGEMENT : 2 : 1
: 1,5 : 1

REMARQUES :

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RÉALISÉ PAR : CHANTAL BÉRARD
VÉRIFIÉ PAR : MICHEL LAURIN

DATE : 11-05-19
DATE : 11-05-19