

# **Specifications**

## **Issued for Tender**

**Volume 2 – Mechanical, Electrical, Civil and Appendices**

**Government of Canada Building**

**Bay d'Espoir, NL**

**PROJECT NO. 1005744**



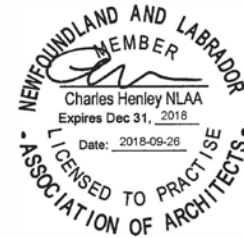
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26 Sept 2018



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END OF SECTION



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**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 American National Standards Institute/National Sanitation Foundation (ANSI/NSF).
  - .1 ANSI/NSF 61, Drinking Water System Components.
- .3 American Society for Testing and Materials International (ASTM).
  - .1 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .3 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).
  - .4 ASTM F 492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe Fittings.
- .4 American Water Works Association (AWWA).
  - .1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .2 AWWA C606, Grooved and Shouldered Joints.
- .5 Canadian Standards Association (CSA International).
  - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .6 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA).
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.9 National Research Council (NRC)/Institute for Research in Construction.

.1 NRCC 38728, National Plumbing Code of Canada (NPC).

.10 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA).

## **1.2 SUBMITTALS**

.1 Submittals in accordance with 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 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Hazardous Materials.

.4 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Closeout Submittals section.

.5 Grooved joint couplings and fittings to be indicated on product submittals and to be specifically identified with the applicable style or series designation.

## **1.3 HEALTH AND SAFETY**

.1 Do construction occupational health and safety in accordance with Health and Safety Requirements.

## **1.4 WASTE MANAGEMENT AND DISPOSAL**

.1 Separate waste materials for reuse and recycling in accordance with Construction/ Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Federal, Provincial, and Municipal regulations.

.6 Fold up metal banding, flatten and place in designated area for recycling.

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**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.

**2.2**            **FITTINGS**

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: 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 NPS2 and larger: roll grooved to CSA B242. Cast bronze to ANSI/ASME B16.18 or wrought copper ANSI/ASME B16.22.
  - .1 Fittings to be manufactured to copper-tube dimensions. Flaring of tube or fitting ends to accommodate IPS sized couplings is not permitted.
- .6 NPS 1 ½ and under: Cast copper, ANSI/ASME B16.18 or wrought copper, ANSI/ASME B16.22; with 301 stainless steel internal components, EPDM seal, and push-to-connect joints.

**2.3**            **JOINTS**

- .1 Rubber gaskets, latex-free, 1.6 mm thick: to ANSI/AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 tin copper alloy lead free.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket. Gasket to be classified in accordance with ANSI/NSF 61 for potable water service. Couplings to be manufactured to copper-tube dimensions. Flaring of tube or fitting ends to accommodate IPS sized couplings is not permitted.
- .6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

## **2.4 GATE VALVES**

- .1 NPS2 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 NPS2 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 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 NPS2 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.
- .3 NPS 2 and under, push-to-connect, lift-disc type:
  - .1 To MSS-SP-80, 1380 kPa CWP, bronze body, stainless steel disc, spring, and shaft, suitable for installation in horizontal or vertical lines.

## **2.6 BALL VALVES**

- .1 NPS2 and under:
  - .1 As specified Section 23 05 23.01 – Valves - Bronze.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with National Plumbing Code 2015 and local authority having jurisdiction.
- .2 Install pipe work in accordance with Installation of Pipework and by certified journey person supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Grooved joint couplings and fittings to be installed in accordance with the manufacturer's written installation instructions. Grooved ends to be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets to be verified as suitable for the intended service prior to installation. Gaskets to be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained



representative to provide on-site training for Contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative to periodically visit the jobsite and review installation. Contractor to remove and replace any joints deemed improperly installed.

- .5 Install CWS piping below and away from HWS and HWR and other hot piping so as to maintain temperature of cold water as low as possible.
- .6 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .7 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.

### **3.2 VALVES**

- .1 Isolate equipment, fixtures and branches with butterfly or ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

### **3.3 PRESSURE TESTS**

- .1 Conform to requirements of Common Work Results-Mechanical.
- .2 Test pressure: greater of 1 ½ times maximum system operating pressure or 860 kPa.

### **3.4 FLUSHING AND CLEANING**

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory for bacteriological testing to verify that system is clean to Guidelines for Federal Drinking Water Quality . Let system flush for additional 2 h, then draw off another sample for testing.
- .2 Water Quality samples to include the following list of 25 parameters that are typical in general chemistry and metal packages: Total Coliform, E. coli, Aluminium, Antimony, Arsenic, Barium, Boron, Cadmium, Chloride, Chromium, Colour, Copper, Hardness, Iron, Lead, Manganese, Nitrate/Nitrite, pH, Selenium, Sodium, Sulphate, Total Dissolved Solids, Turbidity, Uranium, Zinc.

### **3.5 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 pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

### **3.6 DISINFECTION**

- .1 Flush out, disinfect and rinse system to requirements of Federal authority having jurisdiction and approval of Departmental Representative.
- .2 Coordinate with 33 11 16 - Site Water Utility Distribution Piping section.
- .3 Upon completion, provide laboratory test reports on water quality to Departmental Representative.

### **3.7 START-UP**

- .1 Timing: Start up after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 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 Bring HWS storage tank up to design temperature slowly.
  - .4 Monitor HWS and HWR piping systems for freedom of movement, pipe expansion as designed.
  - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

### **3.8 PERFORMANCE VERIFICATION**

- .1 Timing:
  - .1 After pressure and leakage tests and disinfection 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 HWR in accordance with Testing Adjusting and Balancing for HVAC.
  - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

- .4 Sterilize HWS and HWR 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 off 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, verifying that no residuals remain as a result of flushing and/or cleaning.
- .3 Reports:
- .1 In accordance with General Commissioning (CX) Requirements: using report forms as specified in General Commissioning (CX) Requirements.
  - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section includes:
  - .1 The installation of drainage waste and vent piping – plastic.

**1.2**            **REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM D2235, Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - .2 ASTM D2564, Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA)
  - .1 CSA-B1800 Series, ABS Drain, Waste and Vent Pipe and Pipe Fittings.
  - .2 CSA-B181.2, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
  - .3 CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.
- .3 Underwriters Laboratory of Canada (ULC)
  - .1 CAN/ULC-S102.2 Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

**1.3**            **DELIVERY STORAGE AND DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Separate and recycle waste materials in accordance with Construction/Demolition Waste Management and Disposal.
  - .2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

**1.4**            **SUBMITTALS:**

- .1 Provide submittals in accordance with 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.
- .3 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Closeout Submittals section.

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**PART 2**      **PRODUCTS**

**2.1**      **PIPING AND FITTINGS**

- .1 For buried DWV piping to:
  - .1 CSA-B181.2.
  - .2 CSA-B182.1.
- .2 For aboveground DWV piping for combustible construction:
  - .1 To CSA B181.2
  - .2 Meet NBCC 2015 requirements for combustible piping.

**2.2**      **JOINTS**

- .1 Solvent weld for PVC: to ASTM D2564.
  - .1 NPS 1 ½ to 6: one step or two step cement.
  - .2 NPS 8 and above: two step cement.

**PART 3**      **EXECUTION**

**3.1**      **INSTALLATION**

- .1 In accordance with Installation of Pipework and certified journeyman.
- .2 Install in accordance with National Plumbing Code 2015 and local authority having jurisdiction.

**3.2**      **TESTING**

- .1 Pressure test buried systems before backfilling in accordance with National Plumbing Code 2015.
- .2 Hydraulically test to verify grades and freedom from obstructions.

**3.3**      **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 Storm water drainage:
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.

- .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows in accordance with Mechanical Identification.
- .6 Provide copies of test reports for Commissioning Manuals.

**END OF SECTION**

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**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 01 33 00 – Submittal Procedures.
- .2      Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3      Section 01 78 00 – Closeout Submittals.

**1.2**      **REFERENCES**

- .1      Canadian Standards Association (CSA International)
  - .1      CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
  - .2      CAN/CSA-B139, Installation Code for Oil Burning Equipment.
  - .3      CAN/CSA-B140.0, General Requirements for Oil Burning Equipment.
  - .4      CSA B140.12, Oil-Fired Service Water Heaters and Swimming Pool Heaters.
  - .5      CAN/CSA C22.2 No.110, Construction and Test of Electric Storage Tank Water Heaters.
  - .6      CAN/CSA-C191 Series, Performance of Electric Storage Tank Water Heaters for Household Service.
  - .7      CAN/CSA-C309, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.
- .2      Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.

**1.3**      **SHOP DRAWINGS**

- .1      Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Indicate:
  - .1      Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled, installation procedures.

**1.4**      **CLOSEOUT SUBMITTALS**

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

**1.5**      **WASTE MANAGEMENT AND DIPOSAL**

- .1      Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management And Disposal, and with Waste Reduction Workplan.
- .2      Remove from site and dispose of packaging materials at appropriate recycling facilities.

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

## **1.6 WARRANTY**

- .1 For the Work of this Section 22 30 05 - Domestic Water Heaters, warranty for 3 years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 ELECTRIC**

- .1 To CAN/CSA C22.2 No.110, CAN/CSA-C191 and CAN/CSA-C309 for glass-lined storage tanks, with immersion type incoloy sheath elements, kW rating as indicated and surface mounted or immersion type adjustable thermostats. ASME construction.
- .2 Tank: 189 litre, 9.0 kW, glass lined steel, or stainless steel, 50 mm mineral wool or fiberglass insulation (R-16), anode, enameled steel jacket, control panel, 5 year warranty certificate, capacity and size as indicated, 240V/1/60.

### **2.2 TRIM AND INSTRUMENTATION**

- .1 Drain valve: NPS 1 with hose end.
- .2 Thermometer
- .3 Pressure gauge
- .4 Thermowell filled with conductive paste for control valve temperature sensor.
- .5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
- .6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Provide structural steel for horizontal mounted tanks and for instantaneous heaters.



- .3 Provide insulation between tank and supports.
- .4 Install oil burning domestic water heaters in accordance with CAN/CSA-B139.

**3.2 FIELD QUALITY CONTROL**

- .1 Manufacturer's trained and certified Engineer to start up and commission DHW heaters, as per Section 01 91 13 – General Commissioning (Cx) Requirements.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for plumbing specialties and accessories.

**1.2**            **REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
  - .1 AWWA C700, Cold Water Meters-Displacement Type, Bronze Main Case.
  - .2 AWWA C701, Cold Water Meters-Turbine Type for Customer Service.
  - .3 AWWA C702, Cold Water Meters-Compound Type.
- .3 American National Standards Institute (ANSI)
  - .1 ANSI Z358.1 Emergency eyewash and shower equipment.
- .4 Canadian Standards Association (CSA)
  - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
  - .2 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .5 Health Canada/Workplace Hazardous Materials Information Systems (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .6 Plumbing and Drainage Institute (PDI)
  - .1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
  - .2 PDI-WH201, Water Hammer Arresters Standard.

**1.3**            **SUBMITTALS**

- .1 Submittals in accordance with Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
  - .2 Indicate dimensions, construction details and materials for specified items.
  - .3 Submit WHMIS MSDS in accordance with Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

- .3 Shop Drawings:
  - .1 Submit shop 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 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Closeout Submittals. Include:
  - .1 Description of plumbing specialties and accessories, giving manufacturer's name, type, model, year and capacity.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list.

#### **1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Health and Safety Requirements.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging materials in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
  - .5 Fold up metal and plastic banding flatten and place in designated area for recycling.

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**PART 2**      **PRODUCTS**

**2.1**      **FLOOR DRAINS AND TRENCH DRAINS**

- .1 Floor drains: to CAN3-B79.
- .2 FD-1: general duty; cast iron body, round adjustable head, 125 mm, sediment basket nickel bronze strainer, integral seepage pan and clamping collar, trap primer connection.
- .3 FD-2: combination funnel floor drain; coated cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral oval funnel, trap primer connection.

**2.2**      **HUB DRAINS**

- .1 HD-1: Hub floor drain, size 150 mm, Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with "Type S" circular adjustable hub drain (extend 300 mm above floor) and trap primer tapping.

**2.3**      **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, or stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .2 Floor access: round cast iron body and frame with adjustable secured nickel bronze top.
    - .1 Plugs: bronze with neoprene gasket.
    - .2 Cover for unfinished concrete floors and all detention areas: cast iron round, gasket, vandal-proof screws.
    - .3 Cover for terrazzo finish: polished nickel bronze 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.
    - .5 Cover for carpeted floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

**2.4**      **SHOCK ABSORBERS/WATER HAMMER ARRESTORS**

- .1 Stainless steel bellows or copper or piston construction: to PDI-WH 201.

**2.5**      **BACK FLOW PREVENTERS**

- .1 To CSA-B64 Series.
- .2 Backflow preventers: reduced pressure principle type backflow preventer.

- .1 Application: domestic service entrance and fire protection system service entrance.
  - .1 Domestic water:
    - .1 Reduced pressure principle type consisting of a pressure differential relief valve located between two independently operated spring-loaded centre guided check valves.
    - .2 Ductile iron construction with FDA approved fusion epoxy coat inside and out.
    - .3 Compound check.
    - .4 Single access cover.
    - .5 Maximum temperature range: 0.5°C to 60°C.
    - .6 Maximum pressure: 1205 kPa.
    - .7 CSA certified.
  - .2 Application: install on domestic cold water supply to electrode steam humidifier, laboratory water supply, plumbed equipment (including coffee makers, ice machines, refrigerators)
    - .1 Bronze body construction.
    - .2 Internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs.
    - .3 Seats and discs replaceable in both check modules and the relief valve.
    - .4 Assembly to include two resilient seated isolation valves, four resilient seated test cocks, protective wye strainer with 20 mesh screen, union end connections and an air gap drain fitting.
    - .5 Reduced pressure zone type backflow preventer.
- .3 Provide backflow preventer test kit as follows:
  - .1 Maximum working pressure: 1205 kPa.
  - .2 Maximum working temperature: 98.8°C.
  - .3 0-103 kPa and 0-15 psig dual scale pressure gauge with 114 mm diameter face,  $\pm 2\%$  accuracy.
  - .4 Test valves: two (2) ball valves and one (1) needle valve.
  - .5 Hoses: three (3) one (1) metre test hoses with female threaded swivel coupling.
  - .6 Adapters:
    - .1 Three (3) NPS  $\frac{1}{4}$  threaded coupling adapters.
    - .2 Three (3) NPS  $\frac{1}{2}$  x NPS  $\frac{1}{4}$  bushings.
    - .3 Three (3) NPS  $\frac{3}{4}$  x NPS  $\frac{1}{4}$  bushings.
  - .7 400 mm long securing strap.
  - .8 Moisture resistant instruction guide.
  - .9 Light weight, shock resistant molded plastic case with foam inserts.

## 2.6 VACUUM BREAKERS

- .1 To CSA-B64 Series.
- .2 Atmospheric vacuum breaker (inlet to domestic hot water tanks):
  - .1 Plain brass body with silicone disc.
  - .2 Suitable for temperatures up to 82°C.
  - .3 Maximum operating pressure: 860 kPa.
  - .4 Size: NPS ¾.
- .3 Hose connection vacuum breaker:
  - .1 NPS ¾ female hose thread inlet, NPS ¾ male hose thread outlet, brass finish.

## 2.7 PRESSURE REGULATORS

- .1 Capacity: as indicated.
  - .1 Inlet pressure: 1034 kPa.
  - .2 Outlet pressure: 413 kPa.
  - .3 Capacity: as indicated.
- .2 Up to NPS1-1/2 bronze bodies, screwed: to ASTM B62, strainer and stainless steel strainer screen.
- .3 NPS2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class B, strainer.
- .4 Semi-steel spring chambers with bronze trim.

## 2.8 TRAP SEAL PRIMERS (TP-1)

- .1 Install for all floor drains and elsewhere as indicated.
- .2 Install on cold water supply as indicated, in concealed space. Provide strainer on upstream side of valve; serviceable from valve access door.
- .3 Up to 12 floor drains: Electronic trap priming manifold with:
  - .1 Vacuum breaker
  - .2 Pre-set 24 hour time clock
  - .3 Manual override switch
  - .4 120V solenoid valve
  - .5 120V or 3 wire connection.
  - .6 NPS ¾ inlet connection.
  - .7 Calibrated manifold.
  - .8 Water hammer arrestor
  - .9 Mounted in steel cabinet
  - .10 Compression outlet fittings
  - .11 Inlet shut off valve
  - .12 Supplies minimum 59 ml @ 138 kPa.

## **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, tapped blowoff and plug.
- .3 NPS 2½ and over, cast iron body, flanged ends, with bolted cap, tapped blow off connection with bronze ball valve.

## **2.10 PIPE WALL AND FLOOR PENETRATION SEAL**

- .1 Application:
  - .1 Pipes penetrating exterior concrete walls below grade and concrete floors on grade.
  - .2 Seal material to be EPDM.
  - .3 Pressure plates to be glass-reinforced plastic.
  - .4 Bolts and nuts to be stainless steel 18-8.
  - .5 Suitable temperature range to be -40°C to 121°C.
  - .6 Wall sleeves to be Schedule 40 black iron pipe. Sleeves in exterior walls to be galvanized.
  - .7 Floor sleeves to be Schedule 40 black iron pipe.
  - .8 Wall and floor sleeves to be sufficiently long to mount flush with interior and exterior walls and flush with finished floor of slab-on-grade floors, 50 mm above floor, for floors above grade.

## **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 data sheet.

### **3.2 INSTALLATION**

- .1 Install in accordance with Canadian Plumbing Code, local authority having jurisdiction, and manufacturer's instructions.

### **3.3 FLOOR DRAINS**

- .1 Install in accordance with manufacturer's instructions and as indicated.
- .2 Test floor drains to ensure positive drainage.

### **3.4 CLEANOUTS**

- .1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.
- .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 NPS4.

### **3.5 NON FREEZE WALL HYDRANTS**

- .1 Install 600 mm above finished grade unless otherwise indicated.

### **3.6 WATER HAMMER ARRESTORS**

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

### **3.7 BACK FLOW PREVENTORS**

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
  - .1 Reduced pressure type where backflow would constitute a health hazard.
  - .2 Double check type where backflow would constitute a nuisance or be aesthetically objectionable or material which would not constitute a health hazard.
- .2 Pipe discharge to terminate over nearest drain and or service sink.

### **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 Type K soft copper tubing or flexible plastic tubing, meeting NBCC 2015 requirements for combustible piping, to floor drain.

### **3.10 STRAINERS**

- .1 Install with sufficient room to remove basket.

### **3.11 WATER METERS**

- .1 Install water meter provided by local water authority.
- .2 Install water meter as indicated.



### **3.12 START-UP AND COMMISSIONING**

- .1 General:
  - .1 In accordance with General Commissioning (Cx) Requirements: supplemented as specified herein.
- .2 Timing: Start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

### **3.13 TESTING AND ADJUSTING**

- .1 General:
  - .1 In accordance with General Commissioning (Cx) Requirements: supplemented as specified herein.
- .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, removeability 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 Pressure regulators, PRV assemblies:
  - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .11 Strainers:
  - .1 Clean out repeatedly until clear.
  - .2 Verify accessibility of cleanout plug and basket.
  - .3 Verify that cleanout plug does not leak.
- .12 Hose bibbs, sediment faucets:
  - .1 Verify operation and at all low points.
- .13 Water meters:
  - .1 Verify calibration certificate.
- .14 Commissioning Reports:
  - .1 In accordance with General Commissioning (Cx) Requirements: supplemented as specified herein.
- .15 Training:
  - .1 In accordance with General Commissioning (Cx) Requirements: supplemented as specified herein.
  - .2 Demonstrate full compliance with Design Criteria.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      Section includes:
  - .1            The supply and installation of washroom fixtures and trim.
- .2      Products installed but not supplied under this section as indicated elsewhere in the contract:
  - .1            Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
  - .2            Equipment installed by others.
    - .1            Connect with unions.
  - .3            Equipment not installed
    - .1            Capped for future connection by others.

**1.2**            **REFERENCES**

- .1      American National Standards Institute (ANSI)
  - .1            ANSI 112-19.2, Ceramic Plumbing Fixtures.
- .2      American National Standards Institute/national Sanitation Foundation (ANSI/NSF)
  - .1            ANSI/NSF 61, Drinking Water System Components.
- .3      Canadian Standards Association (CSA)
  - .1            CAN/CSA-B45 Series, Plumbing Fixtures.
  - .2            CAN/CSA-B125, Plumbing Fittings.
  - .3            CAN/CSA-B651, Barrier-Free Design.

**1.3**            **SUBMITTALS**

- .1      Submittals in accordance with Submittal Procedures.
- .2      Product Data: Submit WHMIS MSDS – Material Safety Data Sheets in accordance with Hazardous Materials.
- .3      Submit shop drawings and product data in accordance with Submittal Procedures.
- .4      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.
- .5      Closeout Submittals:

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in 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 QUALITY ASSURANCE**

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

#### **1.5 DELIVERY STORAGE AND DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.
  - .2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .3 Fold up metal and plastic banding, flatten and place in designated area for recycling.

#### **1.6 WARRANTY**

- .1 Provide a written guarantee, signed and issued in the name of the owner, against defective materials and workmanship for a period of one (1) year from the date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.1 FIXTURE PIPING**

- .1 Hot and cold water supplies to fixtures:
  - .1 Chrome plated flexible supply pipes with screwdriver stop, reducers, escutcheon.
- .2 Waste:
  - .1 Brass P-trap with cleanout on fixtures not having integral trap.
  - .2 Chrome plated in exposed places.

#### **2.2 MANUFACTURED FIXTURES**

- .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 and of same type.
- .6 Trim to be product of one manufacturer and of same type.

### 2.3 WATER CLOSETS

- .1 WC-1: Floor-mounted, flush tank.
  - .1 Bowl: vitreous china, syphon jet, elongated rim, close-coupled combination, bowl and bolt caps.
  - .2 Closet tank: vitreous china with tank liner, flapper type flush valve, 6 litres/flush.
- .2 WC-2: Floor-mounted, flush tank, for barrier-free/accessible, 6 litres/flush, construction similar to WC-1, complete with seat cover.

### 2.4 WASHROOM LAVATORIES

- .1 L-1: Wall-hung, integral back:
  - .1 Vitreous china, with splash lip, soap depressions, supply openings on 100 mm centres, front overflow, for concealed arm carrier. Size: 500 x 450 mm.
- .2 L-2: Wall-hung, for accessible/barrier-free.
  - .1 Vitreous china, low shelf, with integral back, contoured front, shallow front basin, front overflow, soap depressions, supply openings on 300 mm centres, concealed arm carrier. Size: 540 X 520 mm.
- .3 Trim (L-1 and L-2):
  - .1 Barrier free, 102 mm two handle, cast brass centerset.
  - .2 Polished chrome plated finish.
  - .3 Heavy duty brass compression structures.
  - .4 90% flow with first ¼ turn of operation, 180°.
  - .5 Positive shutoff even in poor water conditions.
  - .6 Metal hold-down package.
  - .7 Centerset with cast open grid strainer, no pop-up hole, 2-hole installation.
  - .8 Non-aerator 1.9 L/min. vandal resistant.
  - .9 102 mm blade handles, sanitary hood, metal color indexed vandal resistant screws.

### 2.5 ROUGHING-IN OF FIXTURES

- .1 Rough-in for equipment by others complete with valved supplies, wastes and vents, capped.

## **2.6            FIXTURE CARRIERS**

- .1        Included manufactured fixture carriers for all wall mounted plumbing fixtures.

## **PART 3        EXECUTION**

### **3.1            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        For barrier-free washrooms: to comply with most stringent of either NBCC or CAN/CSA B651, or Provincial Building Accessibility Act and Regulations.

### **3.2            ADJUSTING**

- .1        Conform to water conservation requirements specified this section.
  - .1        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        Adjust urinal flush timing mechanisms.
    - .5        Automatic flush valves for urinals and waterclosets: set controls to prevent unnecessary flush cycles during silent hours.
  - .2        Checks.
    - .1        Water closets, urinals: flushing action.
    - .2        Aerators: operation, cleanliness.
    - .3        Vacuum breakers, backflow preventers: operation under all conditions.
  - .3        Thermostatic controls.
    - .1        Verify temperature settings, operation of control, limit and safety controls.

### **3.3            PERFORMANCE VERIFICATION**

- .1        Commission in accordance with General Commissioning Requirements identified in Division 01 specifications.
- .2        Confirm fixture installed matches shop drawings and contract documents.
- .3        Verify fixture trim operation.
- .4        Record sensor flush time for all flush valves and adjust to time suitable to Owner.

- .5 Confirm operation of hands free powered trim in normal and emergency power situations.
- .6 Verify fixtures properly accessible and meet requirements for handicapped accessibility.
- .7 Demonstrate maintenance operations for all fixtures and trim types.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section includes:
  - .1 The supply and installation of plumbing fixtures and trim.
- .2 Products installed but not supplied under this section as indicated elsewhere in the contract:
  - .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
  - .2 Equipment installed by others.
    - .1 Connect with unions.
  - .3 Equipment not installed.
    - .1 Capped for future connection by others.

**1.2**            **REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA-B45 Series, Plumbing Fixtures.
  - .2 CAN/CSA-B125, Plumbing Fittings.
  - .3 CAN/CSA-B651, Barrier-Free Design.

**1.3**            **SUBMITTALS**

- .1 Submittals in accordance with Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS – Material Safety Data Sheets in accordance with Hazardous Materials.
  - .1 Submit shop drawings and product data in accordance with Submittal Procedures.
    - .1 Indicate, for all fixtures and trim:
      - .1 Dimensions, construction details, roughing-in dimensions.
- .3 Closeout Submittals:
  - .1 Submit maintenance data in accordance with 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 QUALITY ASSURANCE**

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

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Waste Management and Disposal.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## **PART 2 PRODUCTS**

### **2.1 MOP SINKS (S-1)**

- .1 Precast 600 mm x 600 mm x 305 mm high terrazzo base, integral 1,200 mm high stainless steel wall guards, chrome plated brass drain body and stainless steel caps on all sides.
- .2 Trim: Faucet with wall brace, cross indexed handles, pail hook, hose outlet, integral stops, vacuum breaker and escutcheons, polished chrome plated finish.
- .3 Accessories: Minimum 760 mm long rubber hose with brass coupling and stainless steel hose bracket.

### **2.2 STAINLESS STEEL COUNTER TOP SINKS**

- .1 S-2: single compartment, ledge-back.
  - .1 From 0.9 mm thick type 302 stainless steel, self-rimming, undercoated, clamps. Overall sizes: 520 x 510 x 250 mm deep.
  - .2 Trim:
    - .1 203 mm center gooseneck faucet.
    - .2 Two handle.
    - .3 Cast brass underbody.
    - .4 Chrome plated stainless steel coverplate.
    - .5 Polished chrome plated finish.
    - .6 Heavy duty brass compression structures, ceramic not acceptable.
    - .7 90% flow with first ¼ turn of operation, 1800 turn.
    - .8 Positive shutoff even in poor water conditions.
    - .9 203 mm wall form swing spout.
    - .10 Flow control aerator 5.7 L/min. vandal resistant.

- .11 102 mm blade handles -sanitary hoods-metal-color indexed- vandal resistant screws.
- .1 Waste fitting: integral stainless steel basket strainer/stopper, tailpiece, cast brass P-trap with cleanout.
- .2 Shut off valves underneath counter.
- .2 S-3: single compartment, ledge-back.
  - .1 From 0.9 mm thick type 302 stainless steel, self-rimming, undercoated, clamps. Overall sizes: 520 x 510 x 200 mm.
  - .2 Trim:
    - .1 203 mm center deckmount faucet.
    - .2 Two handle.
    - .3 Cast brass underbody.
    - .4 Chrome plated stainless steel coverplate.
    - .5 Polished chrome plated finish.
    - .6 Heavy duty brass compression structures, ceramic not acceptable.
    - .7 90% flow with first ¼ turn of operation, 1800 turn.
    - .8 Positive shutoff even in poor water conditions.
    - .9 203 mm wallform swing spout.
    - .10 Flow control aerator 5.7 L/min. vandal resistant.
    - .11 102 mm blade handles -sanitary hoods-metal-color indexed- vandal resistant screws.
    - .1 Waste fitting: integral stainless steel basket strainer/stopper, tailpiece, cast brass P-trap with cleanout.
    - .2 Shut off valves underneath counter

### 2.3 **FIXTURE PIPING**

- .1 Hot and cold water supplies to each fixture:
  - .1 Chrome plated flexible supply pipes each with screwdriver handwheel stop, reducers, escutcheon for exposed supplies.
- .2 Waste:
  - .1 Brass P trap with cleanout on each fixture not having integral trap.
  - .2 Chrome plated in all exposed places.

### 2.4 **ROUGHING-IN OF FIXTURES**

- .1 Rough-in for equipment by others complete with valved supplies, wastes and vents, capped.

**PART 3**      **EXECUTION**

**3.1**            **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, or Provincial Buildings Accessibility Regulations.

**3.2**            **ADJUSTING**

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

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      Section includes:
  - .1      The supply and installation of showers, bathtubs and trim.
  - .2      Products installed but not supplied under this section as indicated elsewhere in the contract:
    - .1      Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
    - .2      Equipment installed by others.
      - .1      Connect with unions.
    - .3      Equipment not installed.
      - .1      Valve and cap for future connection by others.

**1.2**            **REFERENCES**

- .1      Canadian Standards Association (CSA)
  - .1      CAN/CSA-B45 Series, Plumbing Fixtures.
  - .2      CAN/CSA-B125, Plumbing Fittings.
  - .3      CAN/CSA-B651, Barrier-Free Design.
- .2      American Society of Sanitary Engineering (ASSE)

**1.3**            **SUBMITTALS**

- .1      Submittals in accordance with Submittal Procedures.
- .2      Product Data: Submit WHMIS MSDS – Material Safety Data Sheets in accordance with Hazardous Materials.
  - .1      Submit shop drawings and product data in accordance with Submittal Procedures.
  - .1      Indicate for all fixtures:
    - .1      Dimensions, construction details, roughing-in dimensions.
- .3      Closeout Submittals:
  - .1      Provide maintenance data including monitoring requirements for incorporation into manuals specified in 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 QUALITY ASSURANCE**

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

## **1.5 DELIVERY STORAGE AND DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.
  - .1 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .2 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## **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 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.

### **2.2 SHOWERS**

- .1 Valve: thermostatic mixing valve with checkstops, lever handle, graduated Celsius temperature dial, limit stop.
- .2 Movable Head: deluxe hand held spray with chrome-plated 1500 mm long hose and 600 mm long vertical mounting bar and elevated vacuum breaker.
- .3 Acceptable materials: See Schedule and as follows:

**SH-1:** Shower head and valve: Head to have 5.7 L/min maximum flow with brass ball, valve to have pressure balancing cartridge, adjustable hot water limit stop, lever blade handle, and adjustable stop screw. Set limit to 40°C maximum water temperature. Integral service stops required.

- .1 Concealed in-wall single lever pressure balancing shower control valve.

- .2 Requires 54 mm wall cavity.
- .3 Back to back installation capability.
- .4 Solid brass forged body.
- .5 Monitor with scald-guard valve. Maintains balanced pressure of hot and cold water even when a valve is turned on or off elsewhere in the system.
- .6 No volume control-temperature only controlled with handle.
- .7 Field adjustable to limit handle rotation into hot water zone.
- .8 120 degree maximum handle rotation.
- .9 All parts replaceable from the front of the valve.
- .10 Integral stops and checks.
- .11 Polished chrome plated finish.
- .12 Inlets/outlets NPS ½ FIP or NPS ½ copper sweat with adaptors.
- .13 Single shower unit only.
- .14 Vandal resistant metal level handle -57 mm.
- .15 Cast vandal resistant fixed spray showerhead.
- .16 30° spray angle.
- .17 Concealed brass mounting plate.
- .18 SH-1: plastic shower cabinet. (Non-Accessible)
  - .1 Cabinet: molded white acrylic, front ledge drip lip, reinforced shower base
  - .2 Sizes 984 x 1003 x 2000 mm high.
  - .3 Base: slip resistant with chrome plated brass strainer and tailpiece recessed in floor.
  - .4 Accessories: Stainless steel recessed soap dish, Stainless steel curtain rod, plastic curtain and hooks.

### **2.3 ROUGHING-IN OF FIXTURES**

- .1 Rough-in for equipment by others complete with carriers as required, valved supplies, wastes and vents, capped.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
  - .2 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.

**3.2 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 Thermostatic controls. Verify temperature settings, operation of control, limit and safety controls.
  - .4 Report verification checks in Commissioning Manual.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 10 44 16.19 – Fire Extinguishers

**1.2**      **SUBMITTALS**

- .1      Submittals: in accordance with Division 01.
- .2      Shop drawings; submit drawings stamped and signed for approval by Departmental Representative.
- .3      Shop drawings to show:
  - .1      Mounting arrangements.
  - .2      Operating and maintenance clearances.
- .4      Shop drawings and product data accompanied by:
  - .1      Detailed drawings of bases, supports, and anchor bolts.
  - .2      Acoustical sound power data, where applicable.
  - .3      Points of operation on performance curves.
  - .4      Manufacturer to certify current model production.
  - .5      Certification of compliance to applicable codes.
- .5      In addition to transmittal letter referred to in Division 01: use "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6      Fabrication Drawings:
  - .1      Fabrication drawings shall consist of equipment layout including assembly and installation details; and ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications
  - .2      Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.
- .7      Closeout Submittals:
  - .1      Provide operation and maintenance data for incorporation into manual specified in Division 01.
  - .2      Operation and maintenance manual approved by, and final copies deposited with Departmental Representative before final inspection.
  - .3      Operation data to include:
    - .1      Control schematics for systems including environmental controls.



- .2 Description of systems and their controls.
- .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
- .4 Operation instruction for systems and component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .4 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual 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.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Departmental Representative will provide PDF of mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to PDF, revising to show work as actually installed.
  - .3 Use different colour for each service.
  - .4 Make available for reference purposes and inspection.
- .9 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 Engineer / Architect 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.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Division 01.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01.

### **1.4 MAINTENANCE**

- .1 Furnish spare parts in accordance with Division 01 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.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01.

### **1.6 CONFORMANCE**

- .1 The General Conditions, Supplements and Amendments shall govern this Division. This section covers items common to all sections of Division 21, 22 and 23 and is intended to supplement the requirements of Division 01.

## **1.7 WORK INCLUDED**

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.
- .2 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .3 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available.
- .4 Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, establish orderly completion and the delivery of a fully commissioned installation.
- .5 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .6 The most stringent requirements of this and other mechanical sections shall govern. Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise ordered by the Departmental Representative in writing during the bidding period.
- .7 All work shall be in accordance with the Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.

## **1.8 STANDARD OF ACCEPTANCE**

- .1 Means that item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.
- .2 Where other than the standard of acceptance or scheduled/specified manufacturer is selected, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.

- .3 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.
- .4 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.
- .5 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

## **1.9 SCHEDULING**

- .1 Coordinate with Division 1, Construction Schedule.
- .2 Incorporate within the Construction Schedule, a complete and realistic schedule, integrated with, and recognizing the reliance on, other divisions of the work. Take into account the lead time for the review of operating and maintenance manuals, commissioning, verification of system operation by the Departmental Representative and the demonstration and instruction to the Owner. The schedule shall include but not limited to the following items:
  - .1 Installation and testing of piping systems and equipment.
  - .2 Installation and cleaning of duct systems and equipment.
  - .3 Chemical cleaning and treatment of piping.
  - .4 Control system installation.
  - .5 Air/Water balancing
  - .6 Air measurements of existing systems prior to any renovation work.
  - .7 Connection of electrical services to equipment by electrical contractor.
  - .8 Start-up of mechanical equipment and systems.
  - .9 Check-out of control systems.
  - .10 Commissioning of mechanical systems.
  - .11 Demonstration of systems and equipment to Departmental Representative.
  - .12 Demonstration of systems and equipment to Owner.
  - .13 Preparation of maintenance manuals and as-built drawings.
  - .14 Submission of the various documents required prior to substantial performance.

## **1.10 RESPONSIBILITIES**

- .1 Visit the site before or during tendering. Examine all local and existing conditions on which the work is dependent. No consideration will be granted for any misunderstanding, of work to be done, resulting from failure to visit the site.
- .2 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.
- .3 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental Representative during the

tendering period. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.

- .4 Examine carefully the civil, mechanical, electrical, structural and architectural drawings and confirm that the work under this Sub-Contract can be satisfactorily carried out without changes to the building as shown on these plans.
- .5 Be responsible for prompt installation of this work in advance of concrete pouring or similar work. Provide and set sleeves where required.
- .6 During freezing weather, protect all materials in such a manner that no harm can be done to installations already in place and/or to materials and equipment on the job.
- .7 On completion of the work, all tools and surplus and waste materials shall be removed and the work left in a clean and perfect condition.

## **1.11 COORDINATION**

- .1 Thoroughly review the drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Owner, without the Departmental Representative's written approval.
- .2 The drawings indicate the general location and route to be followed by the piping and ductwork. Where details are not shown on the drawings or only shown diagrammatically, the pipes and ductwork shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All ducts and pipes in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All pipes and ducts shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .3 Work out jointly all interference problems on the site with other trades and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference drawings showing exact locations of mechanical equipment within mechanical rooms, service areas, shafts and the ceiling space (See Fabrication Drawings, this section). Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced. Advise the Departmental Representative of space problems before fabricating, or installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced. Remove and replace improperly installed equipment to satisfaction of the Departmental Representative at no extra cost. Extras for improper coordination and removal of equipment to permit remedial work shall not be allowed.
- .4 When open web structural joists are used, obtain structural shop drawings to ensure adequate space is available for installation of pipes and ductwork.

## **1.12 HOISTS AND SCAFFOLDS**

- .1 Provide all necessary interior movable or roller scaffolds, platforms, lifts and ladders for the installation of the mechanical work.

## **1.13 INSPECTION OF WORK**

- .1 The Departmental Representative shall inspect all work prior to it being concealed. All piping below ground must be approved prior to covering.
- .2 All work shall be approved by all authorities having jurisdiction.
- .3 All openings shall be sealed appropriately in particular in fire rated walls and floors. Sealing shall be inspected prior to covering.

## **1.14 CLEANING**

- .1 Comply with Cleaning During Construction and Final Cleaning requirements outlined in Section 01 74 11 – Cleaning.

## **1.15 PROVISION FOR FUTURE EQUIPMENT AND CONSTRUCTION**

- .1 Leave clear spaces designated for future equipment or building expansion. Where dotted lines indicate future installation of ducting, equipment etc. plan for the installation under this contract and ensure clear accessible, unhindered access to the space is allowed for.
- .2 Where contract documents don't clearly indicate the future expansion requirements, but known services are required, provide written "request for information" to the Departmental Representative before making assumptions as to intent.

## **1.16 PERMITS**

- .1 Obtain all required permits and pay all fees therefore and comply with all Provincial, Municipal and other legal regulations and bylaws applicable to the work.
- .2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

## **1.17 CODES, REGULATIONS AND STANDARDS**

- .1 Division 21, 22, 23 work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction. The latest revision of each code and standard shall apply unless otherwise specified in the contract documents:
  - .1 Local Building Bylaws.
  - .2 Canadian Standards Association
  - .3 ASHRAE Handbooks of Recommended Practice

- .4 ASHRAE Standard 62.1
- .5 ASHRAE Standard 55
- .6 ASHRAE Standard 90.1
- .7 CSA Standard B51, Boiler, Pressure Vessel and Pressure Piping Code.
- .8 CSA Standard B52, Mechanical Refrigeration Code.
- .9 Laboratory Biosafety Guidelines
- .10 National Fire Codes
- .11 NFPA 10 Portable Fire Extinguishers
- .12 NFPA 13 Installation of Sprinkler Systems
- .13 National Research Council of Canada
- .14 National Building Code of Canada 2015
- .15 National Plumbing Code of Canada 2015
- .16 National Fire Code of Canada 2015
- .17 Province of Newfoundland and Labrador Acts and Regulations
- .18 FHR 2003
- .19 Underwriter's Laboratories of Canada
- .20 SMACNA HVAC Duct Construction Standards, latest edition.
- .21 Guidelines for seismic restraints of mechanical systems.
- .22 Where these specifications indicate requirements more onerous than the aforementioned codes, the specifically indicated requirements shall be incorporated into the work.

#### **1.18 WARRANTY**

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance, which shall include one (1) complete summer and one (1) complete winter of uninterrupted operation. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.
- .4 The above parties further agree that they will at their own expense promptly investigate any mechanical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guaranty-warranty.

#### **1.19 ENERGY CONSUMPTION**

- .1 Departmental Representative may reject equipment submitted for approval or review on basis of performance or energy consumed or demanded.

**1.20 WORKMANSHIP**

- .1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Departmental Representative and the Trade.
- .2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

**1.21 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT**

- .1 Installed mechanical equipment whose performance is questioned by the Departmental Representative, may be subject to performance verification as specified herein.
- .2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.
- .3 The Departmental Representative will determine by whom testing shall be carried out. When requested, the contractor shall arrange for services of an independent testing agency.
- .4 Testing procedures shall be reviewed by the Departmental Representative.
- .5 Maintain building comfort conditions when equipment is removed from service for testing purposes.
- .6 Promptly provide the Departmental Representative with all test reports.
- .7 Should test results reveal that originally installed equipment meets specified performance requirements, Government of Canada will pay all costs resulting from performance verification procedure.
- .8 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected and the following shall apply:
- .9 Remove rejected equipment. Replace with equipment, which meets requirements of Contract Documents including specified performance requirements.
- .10 Replacement equipment will be subject to performance verification as well; using the same testing procedures on originally installed equipment.
- .11 Contractor shall pay all costs resulting from performance verification procedure.



## **1.22 DRAWINGS AND MEASUREMENTS**

- .1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.
- .2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.

## **1.23 SPARE PARTS**

- .1 Provide 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 for each heat exchanger.
  - .4 One glass for each gauge glass installed.
  - .5 One set of V-belts for each piece of machinery.
  - .6 One filter cartridge for each filter installed (pre and final filters).

## **1.24 EXISTING CONDITIONS**

- .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this section.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 All materials used on this project shall be new and CSA approved unless noted otherwise.

## **PART 3 EXECUTION**

### **3.1 PAINTING, REPAIRS AND RESTORATION**

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

### **3.2 CLEANING**

- .1 Clean interior and exterior of all systems including strainers.

### **3.3 FIELD QUALITY CONTROL**

- .1 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.
  - .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.

### **3.4 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Contractor to 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, troubleshooting 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 Demonstrations may be recorded for future reference.

### **3.5 TRAINING**

- .1 Provide training to Departmental Representative and those designated on all elements and aspects of the mechanical and control systems in accordance with Section 01 91 41 Commissioning (Cx) Training.

### **3.6 PROTECTION**

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

### **3.7 CONCEALMENT**

- .1 Conceal all piping, ductwork and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- .2 Do not install piping and conduit in outside walls or roof slabs unless specifically directed, in which case, install them with the building insulation between them and the outside face of the building.

**3.8 ACCESSIBILITY**

- .1 Install all work to be readily accessible for adjustment, operation and maintenance. Furnish access doors where required in building surfaces for installation by building trades.

**3.9 PROTECTION OF WORK**

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .3 Refinish damaged or marred factory finish.
- .4 Air systems to have air filters installed before fans are operated. Install new air filters before system acceptance.

**3.10 CUTTING, PATCHING, CORING**

- .1 Lay out all cutting, patching, coring required to accommodate the mechanical services. Coordinate with other Divisions.
- .2 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
- .3 Be responsible for correct location and sizing of all openings required under Division 21, 22 and 23 including pipe sleeves and duct openings. Allow oversized openings for fire dampers and pipe penetrations where insulation is specified.
- .4 The performance of actual cutting, patching, coring is specified under other Divisions.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      Use of HVAC systems during construction.

**1.2**            **USE OF SYSTEMS**

- .1      Use of new and/or existing permanent heating and/or ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:
  - .1      Entire system is complete, pressure tested, cleaned, flushed out.
  - .2      Specified water treatment system has been commissioned, water treatment is being continuously monitored.
  - .3      Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .4      There is no possibility of damage from any cause.
  - .5      Supply ventilation systems are protected by 60 % filters, which shall be inspected daily, changed every week or more frequently as required.
  - .6      Return systems have approved filters over all openings, inlets, outlets.
  - .7      All systems will be:
    - .1      operated as per manufacturer's recommendations or instructions.
    - .2      operated by Contractor.
    - .3      monitored continuously by Contractor.
  - .8      Warranties and guarantees are not thereby relaxed.
  - .9      Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
  - .10     Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, and replace filters in air systems.
- .2      Filters specified in this section are over and above those specified in other sections of this project.
- .3      Exhaust systems are not included in any approvals for temporary heating ventilation.
- .4      All diffusers, grilles and equipment is to be covered and protected from dust/debris at all times.

**PART 2**      **PRODUCTS (NOT USED)**

**PART 3**      **EXECUTION (NOT USED)**

**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.

**1.2**      **WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

**1.3**      **QUALITY ASSURANCE**

- .1 Installers to be certified to journeyperson and properly supervised apprentices.

**1.4**      **SUBMITTALS:**

- .1 Provide submittals in accordance with 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.
- .3 Interference Drawings
  - .1 Provide interference and fabrication drawings in accordance with Division 01 and Section 23 05 00. Coordinate with all trades in the preparation of interference drawings.
- .4 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Closeout Submittals section.

**PART 2**      **PRODUCTS (NOT USED)**

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**PART 3**      **EXECUTION**

**3.1**            **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.

**3.2**            **CLEARANCES**

- .1      Comply with requirements specified elsewhere for provision of interference drawings and adequate access to equipment for operation and maintenance.
- .2      Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .3      Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

**3.3**            **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. 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.

**3.4**            **AIR VENTS**

- .1      Install automatic air vents 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.

**3.5**            **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.

### 3.6 PIPEWORK INSTALLATION

- .1 Installation by certified journeyman and properly supervised apprentices.
- .2 Screwed fittings jointed with Teflon tape or pipe dope as recommended by manufacturer.
- .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 the 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 and as indicated.
- .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 as indicated.
- .15 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless otherwise indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
  - .7 Install butterfly valves on chilled water and related condenser water systems only.

- .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .9 Install ball valves for glycol service.
- .10 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 in vertical pipes with downward flow and elsewhere as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

### **3.7 SLEEVES**

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and 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: Provide space for firestopping. Maintain fire rating integrity.
  - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### **3.8 ESCUTCHEONS**

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



### **3.9 PREPARATION FOR FIRESTOPPING**

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Firestopping.
- .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.

### **3.10 FLUSHING OUT OF PIPING SYSTEMS**

- .1 In accordance with Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Cleaning supplemented as specified in relevant sections of other Divisions.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Departmental Representative, 48 hours minimum prior to performance of pressure tests.
- .2 Piping: Test as specified in relevant sections of other sections or Divisions.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of other Divisions.
- .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.
- .8 Record testing procedures and findings on form to become part of Commissioning Report.

### **3.12 COMMISSIONING**

- .1 Commission in accordance with General Commissioning (Cx) Requirements, Division 01.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      Section Includes:
  - .1      Bronze valves.

**1.2**            **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
  - .3      ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .2      American Society for Testing and Materials (ASTM)
  - .1      ASTM A 276, Specification for Stainless Steel Bars and Shapes.
  - .2      ASTM A536, Specification for Ductile Iron Castings.
  - .3      ASTM B 16, Specification for Free-Cutting Brass Rod Bar and Shapes for Use in Screw Machines.
  - .4      ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
  - .5      ASTM B 283, Specification for Copper and Copper Alloy Die Forgings (Hot Pressed)
  - .6      ASTM B 505/B505M, Specification for Copper-Base Alloy Continuous Castings.
  - .7      ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
- .3      Canadian Standards Association (CSA)
  - .1      CSA B242, Groove and Solder Type Mechanical Pipe Couplings.
- .4      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.

**1.3**            **SUBMITTALS**

- .1      Submittals in accordance with Submittal Procedures.
- .2      Product Data: submit WHMIS MSDS – Material Safety Data Sheets in accordance with Hazardous Materials.

- .1 Submit shop drawings and product data in accordance with Submittal Procedures.
- .2 Submit data for valves specified this section.
- .3 Grooved joint couplings and fittings to be indicated on product submittals and to be specifically identified with the applicable style or series designation.
- .3 Closeout Submittals
  - .1 Submit maintenance data for incorporation into manual specified in Closeout Submittals.

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety
  - .1 Do construction occupational health and safety in accordance with Health and Safety Requirements.
  - .2 All grooved joint couplings, fittings, valves, and specialties to be the products of a single manufacturer. Grooving tools to be of the same manufacturer as the grooved components.

#### **1.5 DELIVERY, STORAGE AND DISPOSAL**

- .1 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with Construction/ Demolition Waste Management and Disposal.
  - .2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

#### **1.6 MAINTENANCE**

- .1 Extra Materials
  - .1 Furnish following spare parts:
    - .1 Provide 1 spare valve per 20 of each size (min. 1 valve).

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- .1 Except for specialty valves, to be single manufacturer.
- .2 All products to have Canadian registration numbers (CRN).
- .3 End Connections
  - .1 Connection into adjacent piping/tubing:
    - .1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
    - .2 Copper tube systems.
      - .1 Solder ends ANSI/ASME B16.18.

- .2 Grooved ends to copper tube dimensions and CSA B242.
- .3 Push-to-connect ends to ANSI/ASME B16.22 and manufacturer's standards.
- .4 Lockshield Keys
  - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

## 2.2 GATE VALVES

- .1 Requirements common to all gate valves, unless specified otherwise:
  - .1 Standard specification: MSS SP-80.
  - .2 Bonnet: with hex. shoulders.
  - .3 Connections: with hex. shoulders.
  - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
  - .5 Packing: high grade non-asbestos packing.
  - .6 Handwheel: non-ferrous.
  - .7 Handwheel Nut: bronze to ASTM B62.
  - .8 Class 125, WP=860 kPa steam, 1.4 mPa WOG
  - .9 Class 150 WP=1.03 mPa steam, 2.07 mPa WOG.
- .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
- .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
  - .2 Operator: Handwheel
- .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.
  - .3 Operator: Handwheel
- .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: Handwheel
- .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: Handwheel

## 2.3 CHECK VALVES

- .1 Requirements common to all check valves, unless specified otherwise:

- .1 Standard specification: MSS SP-80.
- .2 Connections: with hex agonal shoulders.
- .3 Class 125, WP=860 kPa steam, 1.4 mPa WOG
- .4 Class 150 WP=1.03 mPa steam, 2.07 mPa WOG
- .5 Class 200 1.4 mPa CWP
- .2 NPS 2 and under, swing type, bronze disc, Class 125:
  - .1 Body: Y-pattern with integral seat at 45°, 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, swing type, bronze disc:
  - .1 Body: Y-pattern with integral seat at 45°, screw-in cap with hex head.
  - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .4 NPS 2 and under, swing type, composition disc, Class 200:
  - .1 Body: Y-pattern with integral seat at 45°, screw-in cap with hex. head.
  - .2 Disc: renewable rotating disc, of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
- .5 NPS 2 and under, horizontal lift type, composition disc, Class150:
  - .1 Body: with integral seat, union bonnet ring with hex. shoulders, cap.
  - .2 Disc: renewable PTFE for steam, #6 composition rotating disc for water, oil or gas service in disc holder having guides top and bottom, of bronze to ASTM B62.
- .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
  - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .7 NPS 2 and under, vertical or horizontal, lift type, 1380 kPa CWP.
  - .1 Disc: 301 stainless steel, center guided.

## 2.4 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.

## 2.5 BALL VALVES

- .1 NPS 2 and under:

- .1 Body and cap: cast high tensile bronze to ASTM B16 or ASTM B62.
- .2 Pressure rating: Class 125, 860 MPa steam.
- .3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders. Push-to-connect, Pressfit ends.
- .4 Stem: tamperproof ball drive.
- .5 Stem packing nut: external to body.
- .6 Ball and seat: replaceable stainless steel or hard chrome, plated brass solid ball and teflon seats.
- .7 Stem seal: TFE, EPDM, Nitrile, Fluoroelastomer with external packing nut.
- .8 Operator: removable lever handle with extension for insulated pipe.
- .9 Cap and drain for drain service.

### **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 Adjoining tube, couplings, and fittings with grooved joint valves shall be copper-tube dimensioned. Flaring tube or fitting ends to accommodate IPS sized valves is not permitted.
- .4 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.
  - .1 Unions are not required in installations using grooved mechanical couplings. The couplings shall serve as unions.

#### **3.2**            **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.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section includes:
  - .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

**1.2**            **REFERENCES**

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
  - .1 Materials Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 ANSI/MSS SP-69, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC)

**1.3**            **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 MSS SP58 or ASME B31.1.
  - .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 all 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 to be in accordance with MSS SP58.

- .2 Performance Requirements
  - .1 Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the National Building Code

#### **1.4 SUBMITTALS**

- .1 Submittals: in accordance with Submittal Procedures.
- .2 Shop drawings: submit drawings stamped and signed for approval by Departmental Representative.
- .3 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.
- .4 Quality assurance submittals: submit following in accordance with 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.
- .5 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified Closeout Submittals

#### **1.5 QUALITY ASSURANCE**

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

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.



**PART 2**      **PRODUCTS**

**2.1**            **GENERAL**

- .1      Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.
- .2      Use components for intended design purpose only. Do not use for rigging or erection purposes.

**2.2**            **PIPE HANGERS**

- .1      Finishes:
  - .1      Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
  - .2      Use electro-plating galvanizing process or 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 and carbon steel retaining clip.
    - .1      Rod: 9 mm UL listed, 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, FM approved where required to MSS-SP58 and 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 FM approved where required to MSS SP69.
  - .2      Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.
- .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 FM approved where required to MSS SP-69.
- .5      Shop and field-fabricated assemblies.
  - .1      Trapeze hanger assemblies: MSS SP-89.
  - .2      Steel brackets: MSS SP-89.
  - .3      Sway braces for seismic restraint systems: to MSS SP-89.
- .6      Hanger rods: threaded rod material to MSS SP-58.

- .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.
- .7 Pipe attachments: material to MSS SP-58.
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation saddles for hot pipework.
  - .4 Oversize pipe hangers and supports for insulated pipes.
- .8 Adjustable clevis: material to MSS SP-69, UL listed FM approved, where required 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.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.
- .10 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

### **2.3 RISER CLAMPS**

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.
- .2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

### **2.4 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP-69, 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 SP-69.

### **2.5 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.

## **2.6 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 to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .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.

## **2.7 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Structural Steel for Buildings. Submit calculations with shop drawings.

## **2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **2.9 PLATFORMS AND CATWALKS**

- .1 To Metal Fabrication.

## **2.10 HOUSE-KEEPING PADS**

- .1 For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Cast-in-place Concrete by Division 3.

## **2.11 OTHER EQUIPMENT SUPPORTS**

- .1 From structural grade steel meeting requirements of Structural Steel for Buildings.
- .2 Submit structural calculations with shop drawings.

## **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, heat pumps, chillers, cooling towers, and elsewhere 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 be 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: most stringent requirements of National Plumbing Code 2015

- .2 Fire protection: to National Fire Code of Canada 2015, Local Regulations, and NFPA 13.
- .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 Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

- .6 Within 300 mm of each elbow.
- .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, comprised of angel iron or c-channel.

### 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.

**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.
  - .2      Sustainable requirements for construction and verification.

**1.2**      **REFERENCES**

- .1      Canadian General Standards Board (CGSB)
  - .1      CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2      CAN/CGSB-24.3, Identification of Piping Systems.

**1.3**      **SUBMITTALS**

- .1      Product Data:
  - .1      Submittals: in accordance with Submittal Procedures.
  - .2      Product data to include paint colour chips, other products specified in this section.
  - .3      Samples:
    - .1      Submit samples in accordance with 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 Submittal Procedures.
- .2      Health and Safety:
  - .1      Do construction occupational health and safety in accordance with Health and Safety Requirements.

**1.5**      **DELIVERY, STORAGE, AND HANDLING**

- .1      Packing, shipping, handling and unloading:
  - .1      Deliver, store and handle in accordance with Common Product Requirements.
  - .2      Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2      Waste Management and Disposal:
  - .1      Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.

- .2 Dispose of unused paint coating material at official hazardous material collections site approved by Departmental Representative.
- .3 Do not dispose of unused paint coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## **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 to be 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 or white anodized aluminum, 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.

### 2.3 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, to 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.
  - .2 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.
- .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
** Add design temperature		
++ Add design temperature and pressure		
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS

## 2.4 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.
- .3 Identify system : e.g. Supply AHU-1,Exhaust F-7.

## 2.5 VALVES, CONTROLLERS

- .1 Brass tags 12 mm diameter with 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.

## 2.6 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in EMCS: Identification. If no EMCS included in project, identification as per this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position, component ID name.

## 2.7 LANGUAGE

- .1 Identification to be in English.

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**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**      **TIMING**

- .1      Provide identification only after all painting specified in Interior Painting has been completed.

**3.3**      **INSTALLATION**

- .1      Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2      Provide ULC and/or CSA registration plates as required by respective agency.

**3.4**      **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 in any way.

**3.5**      **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, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification to be 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.

### **3.6 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.

### **3.7 CLEANING**

- .1 Proceed in accordance with Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus 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      TAB: performed in accordance with the following:
  - .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.
- .2      Names and credentials of TAB personnel to be submitted within 30 days of contract award for security screening.
- .3      Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .4      Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .5      Where instrument manufacturer calibration recommendations are more stringent than those listed in the TAB standard, use manufacturer's recommendations.
- .6      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 SMACNA), 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 so as 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 be 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 so as 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 and 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 all 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 other Divisions.

#### **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:

- .1 Installation of ceilings, doors, windows, other construction affecting TAB.
- .2 Application of weatherstripping, sealing, caulking.
- .3 All pressure, leakage, other tests specified elsewhere in other Divisions.
- .4 All provisions for TAB installed and operational.
- .3 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 Laboratory HVAC systems: plus 10 %, minus 0 %.
  - .2 Other HVAC systems: plus 5 %, minus 5 %.
  - .3 Hydronic systems: plus or minus 10 %.
  - .4 Refrigeration systems: plus or minus 10%.

#### **1.11 ACCURACY TOLERANCES**

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

#### **1.12 INSTRUMENTS**

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be 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 SUBMITTALS**

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

### **1.14 TAB REPORT**

- .1 Format to be 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 3 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

### **1.15 VERIFICATION**

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

### **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. Markings not to be eradicated or covered in any way.

### **1.17 COMPLETION OF TAB**

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



## **1.18 AIR SYSTEMS**

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.
- .2 Do TAB of systems, equipment, components, controls specified in other Divisions.
- .3 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC or NEBB.
- .5 Measurements: to include, but not limited to, following 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, amperage and volts for each stage of electrical heating coils.
- .6 Locations of equipment measurements: To include, but not be limited to, following 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, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

## **1.19 DOMESTIC WATER SYSTEMS**

- .1 Meet requirements as specified for hydronic systems.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: inlet and outlet of heaters, tank, pump, circulator, at controllers, controlled device.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

## **1.20 OTHER SYSTEMS**

- .1 Plumbing systems:
  - .1 Standard: National Plumbing Code.
  - .2 TAB procedures:
    - .1 Flush valves: adjust to suit project pressure conditions.
    - .2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.

- .3 Controlled flow roof drain systems: adjust weirs to suit actual roof conditions, slopes, areas drained.
- .4 Pumped sanitary and storm water systems: test for proper operation at all possible flow rates.
- .5 Pressure reducing station.
- .2 Refrigeration systems forming part of HVAC systems:
  - .1 Standard: CSA B52 – Mechanical Refrigeration Code.
  - .2 As per manufacturer's startup requirements.
  - .3 TAB procedures: Refer to Standard as follows:
    - .1 Suction Pressure and Temperature.
    - .2 Discharge Pressure and Temperature.
    - .3 Suction Superheat
    - .4 Evaporation Pressure and Temperature.

#### **1.21 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 Building pressure conditions:
  - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during winter and summer design conditions.
- .3 Zone pressure differences:
  - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.
- .4 Measurement of spatial noise:
  - .1 Standard: Section 23 32 48 Acoustical Air Plenums.

#### **PART 2 PRODUCTS (NOT APPLICABLE)**

#### **PART 3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

**1.2**            **REFERENCES**

- .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 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  - .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .9 ASTM C921, Standard Practice for Determining 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 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701, Thermal Insulation Polystyrene, Boards and Pipe Covering.
- .6 Model National Energy Code of Canada for Buildings (MNECB)

**1.3**            **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" - will mean "not concealed" as defined herein.
  - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
- .1 CRD: Commercial Round Ductwork,
  - .2 CRF: Commercial Rectangular Finish.

#### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

#### **1.5 SAMPLES**

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

#### **1.6 MANUFACTURERS' INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with Submittal Procedures.
- .2 Installation instructions to include procedures used and installation standards achieved.

#### **1.7 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: certified in performing work of this Section and qualified to standards of TIAC.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### **1.8 DELIVERY, STORAGE AND HANDLING**

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

## **1.9 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Divert unused adhesive material from landfill to official hazardous material collections site approved by Departmental Representative.
- .6 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

## **PART 2 PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

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

### **2.2 INSULATION**

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code 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).
- .4 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.
- .5 See Section 23 31 13.01 for Fire Rated Duct Wrap Enclosure Requirements
- .6 No asbestos permitted in insulation products.

## 2.3 JACKETS

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum:
  - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
  - .2 Thickness: 0.40 mm sheet.
  - .3 Finish: Stucco embossed or corrugated.
  - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
- .4 Stainless steel:
  - .1 Type: 304 or 316 where additional corrosion protection is required.
  - .2 Thickness: 0.25 mm sheet.
  - .3 Finish: Corrugated or stucco embossed.
  - .4 Jacket banding and mechanical seals: 12mm wide, 0.5 mm thick stainless steel.

## 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .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/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.

- .12 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.

### **PART 3**      **EXECUTION**

#### **3.1**            **PRE-INSTALLATION REQUIREMENTS**

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

#### **3.2**            **INSTALLATION**

- .1 Install in accordance with TIAC National Standards.  
.2 Apply materials in accordance with manufacturer's instructions and as indicated.  
.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.  
.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.  
    .1 Hangers, supports to be outside vapour retarder jacket.  
.5 Supports, Hangers in accordance with 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: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

#### **3.3**            **DUCTWORK INSULATION SCHEDULE**

- .1 Insulation types and thicknesses: Conform to following Table:  
.2

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts (exposed)	C-1	yes	50
Round cold and dual temperature supply air ducts (concealed)	C-2	yes	50
Rectangular warm air ducts (exposed)	C-1	no	25
Round warm air ducts (exposed)	C-1	no	25
Rectangular cold and dual temperature supply air ducts (concealed)	C-2	Yes	25
Round cold and dual temperature supply air ducts (exposed)	C-1	yes	50

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular warm air ducts (concealed)	C-2	No	25
Round warm air ducts (concealed)	C-2	No	25
Supply, return and exhaust ducts exposed in space being served			none
Outside air ducts to mixing plenum	C-1	yes	50
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvers	C-1	no	50
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	See Section 23 33 53- Duct Liners		
Fire Rated Duct Wrap	See Section 23 31 13.01		

- .3 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
- .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
  - .2 Finishes: Conform to following table:

	TIAC Code	Round
Indoor, concealed	None	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

**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 Efficient Design of New Buildings Except Low-Rise Residential Buildings (Including all Addenda).
- .2 American Society for Testing and Materials (ASTM)
  - .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 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 Fibre-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C533 Standard specification for Calcium Silicate Insulation Block and Pipe.
  - .6 ASTM C547 Standard Specification for Mineral Fibre 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), c. 37.
  - .2 Canadian Environmental Protection Act, (CEPA), c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets.

- .6 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .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.
- .8 Model National Energy Code of Canada for Buildings (MNECB).

### **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 defined herein.
- .2 TIAC ss:
  - .1 CRF: Commercial Rectangular Finish
  - .2 CPF: Commercial Piping Finish.

### **1.4 SUBMITTALS**

- .1 Submittals: in accordance with Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with 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 Submittal Procedures.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Submittal Procedures.
- .4 Samples:
  - .1 Submit samples in accordance with 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 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 to Departmental Representative.

## **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 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, labeled 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.

## **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.
- .2 Place excess or unused insulation and insulation accessory materials in designated containers.
- .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## **PART 2 PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

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

### **2.2 INSULATION**

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 °C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
  - .1 Insulation: to ASTM C533.
  - .2 Maximum "k" factor: to 0.075 W/m °C @ 500 °C .
  - .3 Design to permit periodic removal and re-installation.
- .4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
  - .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: with vapour retarder jacket to ASTM C534.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: 0.039 W/m – °C.
  - .4 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants
  - .5 Flame spread index less than 25, and smoke developed index less than 50.
- .6 TIAC Code C-2: Mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to CAN/ULC-S702.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702.
- .7 No asbestos permitted in insulation products.

### **2.3 INSULATION SECUREMENT**

- .1 Tape: Self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

### **2.4 CEMENT**

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

## **2.5 VAPOUR RETARDER LAP ADHESIVE**

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

## **2.6 INDOOR VAPOUR RETARDER FINISH**

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

## **2.7 OUTDOOR VAPOUR RETARDER FINISH**

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

## **2.8 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Colours: to match adjacent finish paint. Confirm colour with Departmental Representative.
  - .3 Minimum service temperatures: -20°C.
  - .4 Maximum service temperature: 65°C.
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Thickness: 0.55 mm.
  - .7 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
  - .8 Special requirements:
    - .1 Indoor: flame spread rating 25, smoke developed rating 50.
    - .2 Outdoor: UV rated material at least 0.5 mm thick.
- .2 Canvas:
  - .1 220gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
  - .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum:
  - .1 To ASTM B209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Embossed or corrugated.
  - .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.
- .4 Stainless steel:
  - .1 Type: 316.
  - .2 Thickness: 0.25 mm.
  - .3 Finish: Smooth.
  - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

## **2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS**

- .1 Caulking to: Joint Sealing.

## **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 to be 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 See Plumbing Equipment Insulation.

**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-2.
  - .1 Insulation securements: 18 ga SS wire or 12 mm x 0.51 mm SS bands at 300 mm oc.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-H.
- .3 TIAC Code: A-3.
  - .1 Securements: Tape at 300 mm oc.
  - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
  - .1 Insulation securements: as per manufacturer's recommendation.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-CA.
- .5 TIAC Code: C-2 with vapour retarder jacket.
  - .1 Insulation securements: 18 ga SS wire or 12 mm x 0.5 mm SS bands at 300 mm oc.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .6 Thickness of insulation to be as listed in following table.
  - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)				
			<i>Run out</i>	<i>to 1</i>	<i>1 1/4 to 2</i>	<i>2 1/2 to 4</i>	<i>5 to 6</i>

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			<i>Run out</i>	<i>to 1</i>	<i>1 1/4 to 2</i>	<i>2 1/2 to 4</i>	<i>5 to 6</i>	<i>8 &amp; over</i>
Domestic HWS and Recirc		A-3	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Refrigerant hot gas, liquid, suction	4-13	A-6	25	25	25	25	25	25
Refrigerant hot gas, liquid, suction	Below 4	A-6	25	25	25	25	25	25
Cooling Coil cond. Drain		A-3	25	25	25	25	25	25

.7 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 Aluminium jacket.
- .6 Finish attachments: SS screws or bands, at 150 mm oc. Seals: wing or closed.
- .7 Installation: To appropriate TIAC code CPF/1 through CPF/5.

**3.7 CLEANING**

- .1 Proceed in accordance with 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 installation for copper tubing and fittings for refrigerant.

**1.2**            **RELATED SECTIONS:**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 23 05 05 - Installation of Pipework.

**1.3**            **REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM B 280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA)
  - .1 CSA B52, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
  - .1 EPS1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
  - .2 Environment Canada, Ozone-Depleting Substances Alternatives and Suppliers List.
  - .3 Federal Halocarbon Regulations 2003 (FHR2003) and Amendments

- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .6 Province of Newfoundland and Labrador Boiler, Pressure Vessel and Compressed Gas Regulations

#### **1.4 SUBMITTALS**

- .1 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.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.5 QUALITY ASSURANCE**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Trades people to be journeyman and graduate from a recognized college refrigeration trade program.
- .4 Work to be performed by licensed Refrigeration technician having an "Environmental Awareness Certificate" issued by HRAI and/or Environment Canada.
- .5 Forms for documenting refrigerant installation to be provided by Department Representative and completed by contractor.

## **1.6 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.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
- .4 Separate for reuse and recycling and place in designated containers, steel, metal, plastic waste in accordance with Waste Management Plan (WMP).
- .5 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Supply and install in strict accordance with Federal Halocarbon Regulations 2003 and Amendments. Equipment leak test required upon arrival on site (if factory charged) and repeat prior to start-up.

### **2.2 TUBING**

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

### **2.3 FITTINGS**

- .1 Service: design pressure 2070 kPa and temperature 121°C.
- .2 Brazed:
  - .1 Fittings: wrought copper to ASME B16.22.
  - .2 Joints: silver solder, 45% Ag - 80% Cu - 5% P and non-corrosive flux for copper to steel or brass; Silfoss-15 for copper to copper.
- .3 Flanged:
  - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300, tongue and groove type.
  - .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.

## **2.4 PIPE SLEEVES**

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

## **2.5 VALVES**

- .1 7/8 ODS and under: Class 500, 3.5 MPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moistureproof seal for below freezing applications, brazed connections.
- .2 Over 7/8 ODS: Class 375, 3 MPa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and forged brass bonnet, moisture-proof seal for below freezing applications, brazed connections, non-rotating, self aligning swivel disc, Teflon seat, -40<sup>0</sup>C - 163<sup>0</sup>C.
- .3 Ball valves 7 3/8 ODS to 3 1/8 ODS: maximum WP 4MPa, -40<sup>0</sup>C to 149<sup>0</sup>C, live loaded stem seal, double "O" ring hermetically sealed body, blowout proof stem, seal cap "O" ring sealed, valve position indicators, forged brass body bonnet, brass cap, triple sealed plated steel item, Teflon ball seals and gasket, extended copper connections, helium leak test to maximum 0.28 g/yr.
- .4 Check valves 7/8 ODS to 3 1/8 ODS cast bronze body, brass bonnet, Teflon seat, internal parts removable minimum opening pressure 3.5 kPa, maximum WP 3.5 kPa - 29<sup>0</sup>C to 149<sup>0</sup>C, UL and CSA approved.
- .5 Check valves 3/8 ODS to 7/8 ODS: brass construction, Teflon seal, removable piston, maximum WP 3.5 kPa, -40<sup>0</sup>C to 149<sup>0</sup>C, suitable for high side, low side and hot gas. UL and CSA approved, maximum opening pressure 3.5 kPa.

## **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 GENERAL**

- .1 In accordance with Section 23 05 05 – Installation of Pipework, supplemented as specified herein.
- .2 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5.

### **3.3 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.

### **3.4 PIPING INSTALLATION**

- .1 General:
  - .1 Soft annealed copper tubing: bend without crimping or constriction, hard drawn copper tubing: do not bend. Minimize use of fittings.
  - .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 1800 mm high and at each 6000 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 above.
      - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

### **3.5 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 2MPa and 1MPa on high and low sides respectively.
- .3 Test Procedure: Build pressure up to 35 kPa using nitrogen leave for 8 hours.

### **3.6 FIELD QUALITY CONTROL**

- .1 Complete leak test tag for each system installed, as required by FHR 2003.
- .2 Site Tests/Inspection
  - .1 Close service valves on factory charged equipment.
- .3 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
- .4 Use copper lines for largest practical size to reduce evacuation time.
- .5 Use two-stage vacuum pump with gas ballast on 2<sup>nd</sup> stage capable of pulling 5 Pa

- absolute and filled with dehydrated oil.
- .6 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
  - .7 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 h.
    - .2 Break vacuum with refrigerant to 14 KPa.
    - .3 Final to 5 Pa absolute and hold for at least 12 h.
    - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
    - .5 Submit test results to Departmental Representative.
  - .8 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.
  - .9 Checks:
    - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
    - .2 Record and report measurements to Departmental Representative.
  - .10 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.

**3.7 DEMONSTRATION**

.1 Instructions:

- .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 – Closeout Submittals and CSA B52.
- .1 Perform cleaning operations as specified in Section 01 74 11 – Cleaning and in accordance with manufacturer's recommendations.
- .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**      **SUMMARY**

- .1 Section includes:
  - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

**1.2**      **REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A 480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A 635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A 653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA).
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .5 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.
- .6 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, 1st Edition.
- .7 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA).



### **1.3 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Hazardous Materials for the following:
  - .1 Sealants.
  - .2 Tape.
  - .3 Proprietary Joints.

### **1.4 QUALITY ASSURANCE**

- .1 Certification of Ratings:
  - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Health and Safety Requirements.
  - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
  - .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

**PART 2**      **PRODUCTS**

**2.1**      **SEAL CLASSIFICATION**

.1      Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
> 1000	A
750	B
500	C
250	C
125	C

.2      Seal classification:

- .1      Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2      Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
- .3      Class C: transverse joints and connections made air tight with gaskets, sealant tape or combination thereof. Longitudinal seams unsealed.

**2.2**      **SEALANT**

.1      Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°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 Duct Leakage Test Manual.

**2.5**      **FITTINGS**

.1      Fabrication: to SMACNA.

.2      Radiused elbows:

- .1      Rectangular: Centreline radius: 1.5 times width of duct.
- .2      Round: smooth radius or five piece. 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 radius on branch 1.5 times width of duct or 45° entry on branch.

- .2 Round main and branch: enter main duct at 45<sup>0</sup> with conical connection.
- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with volume control damper.
- .5 Transitions:
  - .1 Diverging: 20 degree maximum included angle.
  - .2 Converging: 30 degree maximum included angle.
- .6 Offsets:
  - .1 Full short radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

## **2.6 FIRESTOPPING**

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Firestopping.
- .2 Firestopping material and installation must not distort duct.

## **2.7 GALVANIZED STEEL**

- .1 Lock forming quality: to ASTM A653, G90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

## **2.8 STAINLESS STEEL**

- .1 To ASTM A480/A480M, Type 304.
- .2 Finish: No 4. finish on exposed side of duct in finished area's, No. 3 finish or lower where concealed.
- .3 Thickness, fabrication and reinforcement: to SMACNA.
- .4 Joints: to SMACNA and be continuous inert gas welded.

## **2.9 ALUMINUM**

- .1 To SMACNA. Aluminum type: 3003-H-14.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA and be continuous weld.

## **2.10 HANGERS AND SUPPORTS**

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: galvanized steel angle with black steel rods to ASHRAE or SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.
  - .2 For steel joist: manufactured joist clamp steel plate washer.
  - .3 For steel beams: manufactured beam clamps.

## **2.11 FIRE RATED DUCT WRAP ENCLOSURE**

- .1 Flexible high temperature insulation rated to 1200°C that is fully encapsulated in FSP facing. The duct enclosure system shall be listed by UL and /or ULC per ASTM E 2336, CAN/ULC S144 and ISO 6944 for 1-, 2- and 3-hour rating and zero clearance to combustibles, and tested per ASTM E84 for a flame/ smoke rating less than 25/50. Insulation shall have a nominal thickness of 38 mm and density of 96 kg/m<sup>3</sup>. Insulation shall have a R-Value of 7.3 at 24°C. Installation shall be in strict accordance to manufacturers published installation instructions, UL or ULC Listings, and shop drawings. Duct access cutouts shall be provided where specified and as required by National Building Code and be in accordance with manufacturer's requirements to maintain compliance.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- .1 Do work in accordance with NFPA 90A, NFPA 90B, and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation. Do not place fire stopping material in expansion space between damper sleeve and fire partition.

- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

### 3.2 HANGERS

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

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

### 3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
  - .1 Fresh air intake.
  - .2 Minimum 3000 mm from duct mounted humidifier in all directions.
  - .3 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards fume hoods served. Slope header ducts down toward risers.
- .4 Fit base of riser with 150 mm deep drain sump and NPS 1 ½ drain connected, with deep seal trap and valve and discharging to open funnel drain or service sink or as approved by Departmental Representative.

### 3.4 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations. Sealant and tape to be applied to full perimeter of duct.

### 3.5 LEAKAGE TESTS/COMMISSIONING

- .1 Refer to 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 Install no 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° elbows.
- .7 Complete test before insulation or concealment.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes:
  - .1 Materials and performance criteria for sound attenuation for mechanical systems.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

**1.3**            **REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM C 423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .3 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .4 ASTM E 477, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 National Building Code (NBC).
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

**1.4**            **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.
    - .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:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Provide separate shop drawings for each piece of attenuation equipment, system shop drawings complete with product data.
- .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.

## **1.5 PERFORMANCE REQUIREMENTS**

- .1 Rating Data:
  - .1 Provide performance rating data, certified by professional engineer licensed to practice in Newfoundland and Labrador, or an accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:
    - .1 Silencer: insertion loss, pressure drop at design conditions, generated noise level.
    - .2 Acoustic plenums: transmission loss and acoustical absorption.
    - .3 Acoustical performance measurements in accordance with ASTM E 477, ASTM E 90 and ASTM C 423, except where specified otherwise.

## **1.6 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.

## **1.7 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.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: 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 ABSORPTION AND INSULATING MEDIA**

- .1 Acoustic quality, glass fibre, free of shot and odour; bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of authority having jurisdiction for duct lining. No asbestos permitted.



## **2.2 SILENCERS**

- .1 Factory manufactured of prime coated or galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA standards.
- .2 Outer casing and galvanized steel inner casing with clean cut circular perforations to enclose acoustic media. Inner casing to have half-splitters running full length of silencer where any cross sectional dimension exceeds 450 mm. Protect media from erosion with tedlar or mylar between media and perforated metal.
- .3 Performance: see silencer schedule.
- .4 Provide STC rated cross talk silencers as indicated. See schedule.

## **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 Noise flanking: where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non hardening caulking on both sides of sleeves.
- .2 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.
- .3 Suspension: to manufacturer's instructions.

### **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 three (3) working days of manufacturer representative's review.

### **3.4 ADJUSTING**

- .1 Make adjustments and corrections in accordance with written report.

- .2 Provide Departmental Representative with notice two (2) working days in advance of visit.

### **3.5 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 installation for duct accessories including flexible connections, access doors, vanes and collars.

**1.2**            **REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA – HVAC Duct Construction Standards – Metal and Flexible.

**1.3**            **SUBMITTALS**

- .1 Submittals in accordance with Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.
    - .5 Security grilles
  - .2 Submit WHMIS MSDS in accordance with Hazardous Materials. 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.
  - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 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: manufacturer's field reports specified.

- .7 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Closeout Submittals.

## **1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Health and Safety Requirements.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
  - .4 Separate for reuse and recycling and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan (WMP).
  - .5 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

## **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 0.66 mm 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<sup>0</sup>C to plus 90<sup>0</sup>C, density of 1.3 kg/m<sup>2</sup>.

### **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.
- .4 Hardware:
  - .1 Hold open devices.
  - .2 300 x 300 mm glass viewing panels.
  - .3 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .4 301 to 450 mm: four sash locks complete with safety chain.
  - .5 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .6 Doors over 1000 mm: piano hinge and two handles operable from both sides.
    - .1 Hold open devices.
    - .2 300 X 300 mm glass viewing panels.

### **2.4 TURNING VANES**

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

### **2.5 INSTRUMENT TEST PORTS**

- .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.

### **2.7 SECURITY GRILLES**

- .1 Provide in accordance with drawing details where indicated and scheduled.

**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 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 Size:
    - .1 600 x 600 mm for person size entry.
    - .2 450 x 450 mm for servicing entry.
    - .3 300 x 300 mm for viewing.
    - .4 As indicated.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Balancing dampers
    - .4 Devices requiring maintenance.
    - .5 Required by code.
    - .6 Reheat coils.
    - .7 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.
- .5 Security grilles
  - .1 As indicated on plans.

### 3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer's representative 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.

### 3.4 CLEANING

- .1 Perform cleaning operations as specified in Cleaning and in accordance with Manufacturer's recommendations.

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

**END OF SECTION**



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**PART 1**      **GENERAL**

**1.1**      **SUMMARY**

- .1 Section Includes:
  - .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

**1.2**      **REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3**      **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.
    - .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 Indicate the following:
    - .1 Performance data.
    - .2 Specifications
- .2 Quality assurance submittals: submit following in accordance with 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.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Closeout Submittals

**1.4**      **QUALITY ASSURANCE**

- .1 Health and Safety Requirements: Do construction occupational health and safety in accordance with Health and Safety Requirements.
- .2 Certificates:

- .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

## **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 Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.

## **PART 2 PRODUCTS**

### **2.1 MULTI-LEAF DAMPERS**

- .1 Opposed or parallel blade type as indicated.
- .2 Structurally formed steel or extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel or 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 Operator: to EMCS: Field Control Devices.
- .6 Performance:
  - .1 Leakage: in closed position to be less than 2% of rated air flow at 500 Pa differential across damper.
  - .2 Pressure drop: at full open position to be less than 25 Pa differential across damper at 10 m/s.
- .7 Insulated aluminum dampers:
  - .1 Frames: insulated with extruded polystyrene foam with RSI factor of 5.0.
  - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI factor of 5.0.

## **2.2 DISC TYPE DAMPERS**

- .1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A 653M.
- .2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A 653M.
- .3 Gasket: extruded neoprene, field replaceable, with 10 year warranty.
- .4 Bearings: roller self lubricated and sealed.
- .5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.
- .6 Performance:
  - .1 Leakage: in closed position to be less than 2 % of rated air flow at 500 Pa pressure differential across damper.
  - .2 Pressure drop: at full open position to be less than 25 Pa differential across damper at 10 m/s.

## **2.3 BACK DRAFT DAMPERS**

- .1 Automatic gravity operated, multi leaf, aluminum or steel construction with nylon bearings, centre pivoted, spring assisted or counterweighted.

## **2.4 RELIEF DAMPERS**

- .1 Automatic multi-leaf steel or aluminum dampers with ball bearing centre pivoted and counter-weights set to open as indicated.

## **PART 3 EXECUTION**

### **3.1 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 Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

### **3.2 CLEANING**

- .1 Proceed in accordance with Cleaning.

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

### **3.3 COMMISSIONING**

- .1 In accordance with General Commissioning (Cx) Requirements: supplemented as specified herein.
- .2 Include performance verification results on approved PV Report Forms.
- .3 Coordinate with Division 25.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **SUMMARY**

- .1 Section Includes:
  - .1 Fire and smoke dampers, and fire stop flaps.

**1.2**      **REFERENCES**

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  - .1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN4-S112, Fire Test of Fire Damper Assemblies.
  - .2 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
  - .3 ULC-S505, Fusible Links for Fire Protection Service.

**1.3**      **SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with 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 Submittal Procedures.
  - .2 Indicate the following:
    - .1 Fire dampers.
    - .2 Smoke dampers.
    - .3 Fire stop flaps.
    - .4 Operators.
    - .5 Fusible links.
    - .6 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with 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.

- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Closeout Submittals

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Health and Safety Requirements.
- .2 Certificates:
  - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

#### **1.5 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Closeout Submittals.
  - .2 Provide the following:
    - .1 6 fusible links of each type.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.

### **PART 2 PRODUCTS**

#### **2.1 FIRE DAMPERS**

- .1 Fire dampers: arrangement Type B or C, blades out of air stream listed and bear label of ULC, meet requirements of provincial fire authority and ANSI/NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN4-S112. Minimum rating 1 ½ hours, dynamically rated.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: offset, round or square; multi-blade hinged or interlocking type; roll door type; or guillotine type; sized to maintain full duct cross section.

- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 Retaining angle iron frame, 40 x 40 x 3 mm, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed to prevent disruption of ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC and in manufacturer's instructions for fire dampers shall be followed.

## **2.1 SMOKE DAMPERS**

- .1 To be ULC or UL listed and labelled.
- .2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.
- .3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units mounted horizontally in vertical ducts.
- .4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
- .5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74° C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

## **2.2 COMBINATION FIRE AND SMOKE DAMPERS**

- .1 Damper: similar in all respects to smoke dampers specified above.

- .2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

### **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 ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Air Duct Accessories.
- .5 Coordinate with installer of firestopping to Firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

#### **3.3      CLEANING**

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

#### **3.4      COMMISSIONING**

- .1 Commission in accordance with General Commissioning (Cx) Requirements, ULC listing, and manufacturer's requirements.

**END OF SECTION**



**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      Section Includes:
  - .1      Fans, motors, accessories, and hardware for commercial use.

**1.2**            **REFERENCES**

- .1      Air Conditioning and Mechanical Contractors (AMCA)
  - .1      AMCA Publication, Standards Handbook.
  - .2      AMCA 300, Reverberant Room Method for Sound Testing of Fans.
  - .3      AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2      American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1      ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3      Canadian General Standards Board (CGSB)
  - .1      CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .4      Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1      Material Safety Data Sheets (MSDS).
- .5      National Electrical Manufacturers Association (NEMA)
  - .1      NEMA MG 1 Motors and Generators
  - .2      NEMA ICS 7.1 Safety Standard for Construction and Guide for Selection, Installation and Operation of Adjustable Drive Systems.

**1.3**            **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 static pressure, bhp W, 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 AMCA 99.
  - .4      Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.

- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

#### **1.4 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with 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 Submittal Procedures.
  - .2 Shop Drawings:
    - .1 Submit shop drawings and product data in accordance with Submittal Procedures.
  - .3 Provide:
    - .1 Fan performance curves showing point of operation, BHP kW and efficiency.
    - .2 Sound rating data at point of operation.
    - .3 Dimensional data.
    - .4 Installation procedures.
  - .4 Indicate:
    - .1 Motors, sheaves, bearings, shaft details
    - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.
  - .5 Quality assurance submittals: submit following in accordance with 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.
  - .6 Closeout Submittals:
    - .1 Provide operation and maintenance data for incorporation into manual specified in Closeout Submittals.

#### **1.5 QUALITY ASSURANCE**

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

#### **1.6 MAINTENANCE**

- .1 Extra Materials:

- .1 Provide maintenance materials in accordance with Closeout Submittals.
  - .1 Spare parts to include:
    - .1 Matched sets of belts.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
  - .1 Bearings and seals.
  - .2 Belts
  - .3 Addresses of suppliers.
  - .4 List of specialized tools necessary for adjusting, repairing or replacing.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.

## **PART 2 PRODUCTS**

### **2.1 FANS GENERAL**

- .1 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
- .5 Motors:
  - .1 Open drip proof outside of air stream, TEFC when in air stream, explosion proof as indicated in accordance with NEMA MG1.
  - .2 In accordance with Common Motor Requirements for HVAC Equipment supplemented as specified herein.
  - .3 For use with variable speed controllers where specified.
  - .4 Sizes as specified.

- .6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards, fan inlet and/or outlet safety screens as indicated and as specified in Common Motor Requirements for HVAC Equipment, inlet or outlet dampers and vanes and as indicated.
- .7 Factory primed before assembly in colour standard to manufacturer.
- .8 Scroll casing drains: as indicated.
- .9 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .10 Vibration isolation: to Vibration and Seismic Control for HVAC Piping and Equipment.
- .11 Flexible connections: to Air Duct Accessories.

## 2.2 CENTRIFUGAL FANS

- .1 Fan wheels:
  - .1 Welded steel or aluminum construction.
  - .2 Maximum operating speed of centrifugal fans not more than 40 % of first critical speed.
  - .3 Air foil or backward inclined blades, as indicated.
- .2 Bearings: air handling quality, heavy duty, split pillow-block, flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life to ABMA L10 of 100,000 hours. Shaft seals on laboratory fume hood and biological safety cabinet exhaust fans:
  - .1 Single disc or stuffing box seals.
- .3 Housings:
  - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, cast iron, or steel, for smaller wheels, braced, and with welded supports.
  - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
  - .3 Provide bolted latched airtight access doors with handles.
  - .4 Spark resistant construction Type B minimum where indicated.
- .4 Variable volume control devices:
  - .1 Mounted by fan manufacturer.
  - .2 Adjustable inlet vanes: operated from a centre mechanism linked to each damper vane. Support each vane at ends in bronze bearings. On DWDI fans interconnect vanes to operate in unison. Provide locking devices for manual operation.
  - .3 Variable Speed Drives: to NEMA ICS 7.1.

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**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**      **FAN INSTALLATION**

- .1      Install fans as indicated, complete with resilient mountings specified in Vibration and Seismic Control for HVAC and Piping Equipment, flexible electrical leads and flexible connections in accordance with 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**      **CLEANING**

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

**3.4**      **COMMISSIONING**

- .1      Commissioning in accordance with General Commissioning (Cx) Requirements.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section includes:
  - .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial HVAC use.

**1.2**            **REFERENCES**

- .1 American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE).
  - .1 ASHRAE 70, Method of Testing for Rating the Performance of Air Ducts and Outlets.

**1.3**            **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.

**1.4**            **SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with 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 Submittal Procedures.
    - .2 Indicate following:
      - .1 Capacity
      - .2 Throw and terminal velocity
      - .3 Noise criteria
      - .4 Pressure drop
      - .5 Neck velocity
  - .2 Quality assurance submittals: submit following in accordance with 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.

## **1.5 QUALITY ASSURANCE**

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

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.

## **1.7 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Closeout Submittals.
  - .2 Include:
    - .1 Keys for volume control adjustment
    - .2 Keys for air flow pattern adjustment.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board.
  - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators as indicated.
- .4 Colour: standard or as directed by Departmental Representative.

### **2.2 MANUFACTURED UNITS**

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer except for specialty items required for security measures.

**2.3 SUPPLY GRILLES AND REGISTERS**

- .1 See Schedule.

**2.4 RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1 See Schedule.

**2.5 DIFFUSERS**

- .1 See Schedule.

**2.6 LINEAR GRILLES**

- .1 See Schedule.

**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 manufacturers instructions.  
.2 Install with flat head stainless steel or cadmium plated screws in countersunk holes where fastenings are visible.

**3.3 CLEANING**

- .1 Proceed in accordance with 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 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.

**1.2**            **REFERENCES**

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
  - .1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .5 Society of Automotive Engineers (SAE)

**1.3**            **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.

**1.4**            **SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with 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 Submittal Procedures.
    - .2 Indicate following:
      - .1 Pressure drop.
      - .2 Face area.

- .3 Free area.
- .4 Dimensions
- .2 Quality assurance submittals: submit following in accordance with 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.
- .3 Test Reports:
  - .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

## **1.5 QUALITY ASSURANCE**

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

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.

## **PART 2 PRODUCTS**

### **2.1 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 with approved caulking slot, integral to unit. Flanged frame or flush frame as indicated.
- .5 Mullions: at 1500 mm maximum centres.

- .6 Fastenings: stainless steel with nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm on exhaust and intake mesh, 2 mm diam wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel, or anodized as indicated. Colour: to Departmental Representative's approval.

### **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 In accordance with manufacturer's and SMACNA recommendations.
- .2 Provide security bars where indicated and in accordance with details.
- .3 Reinforce and brace as indicated.
- .4 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

#### **3.3**            **CLEANING**

- .1 Proceed in accordance with 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 Bearing Manufacturer's Association (ABMA)
  - .1        ANSI/ABMA 9 Load Ratings and Fatigue Life for Ball Bearings.
  - .2        ANSI/ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- .2        Air Movement and Control Association (AMCA)
  - .1        AMCA 210, Laboratory Method of Testing Fans for Aerodynamic Performance Rating (ASHRAE).
  - .2        AMCA 300 Reverberant Room Method for Sound Testing of Fans.
- .3        American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
  - .1        ANSI/ARI 430, Central Station Air Handling Units.
- .4        American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1        ASHRAE 68, Laboratory Method of Testing to Determine the Sound Power in a Duct.
  - .2        ASHRAE 84, Method of Testing Air-to-Air Exchangers.
- .5        Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .6        Canadian Standards Association (CSA)
  - .1        CSA B52 Mechanical Refrigeration Code.
- .7        National Electrical Manufacturer's Association (NEMA)
  - .1        NEMA MG1 Motors and Generators
  - .2        NEMA ICS 7-1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
- .8        Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.
- .9        Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

### **1.2            SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Indicate following: fan, fan curves showing point of operation, motor drive, bearings, filters, mixing box, dampers, VAV, coil, include performance data.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include following: fan, bearings, motor, damper, VAV control, air volume, total cooling, sensible cooling, EDB,EWB, OAT.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and with the Waste Reduction Workplan.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .4 Divert unused paint material from landfill to official hazardous material collections site approved by Departmental Representative.
- .5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

### **1.5 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one 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 for startup and commissioning. Immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

## **PART 2 PRODUCTS**

### **2.1 HEAT RECOVERY VENTILATORS**

- .1 Construction

- .1 The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
- .2 No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.
- .3 The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc-plated screw fasteners.
- .4 Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.
- .5 Case walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft<sup>2</sup>·°F/BTU).
- .6 The ERV cores shall be protected by a MERV-8 rated, 2" nominal, pleated, disposable filter in both airstreams.
- .7 Unit shall have single-point power connection and a single-point 24 VAC contactor control connection.
- .8 Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and be shall be supplied with factory installed motor starters.
- .9 Blowers shall be quiet running, forward curve or backward inclined type and be either direct drive or belt drive. Belt drive motors shall be provided with adjustable pulleys and motor mounts allowing for blower speed adjustment, proper motor shaft orientation and proper belt tensioning.
- .10 The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.
- .11 The ERV shall be provided "inverter-ready" allowing for applications of inverters supplied and installed by others.
- .12 Provide unit and duct connection orientation per project schedule.
- .13 Provide double wall construction with 24-gauge galvanized steel liner.
- .14 Provide MERV-13 filters for final installation after construction phase.
- .15 Provide ECM controlled motors for variable speed operation with a 0-10 volt DC control signal.
- .16 Provide isolation dampers for both air streams. The insulated dampers shall be of a low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit transformer package and have a spring return for low off- position power consumption.
- .17 The unit shall have duct openings that when properly ducted can by-pass the air around the energy recovery core automatically to deliver outside air to the space when the conditions are appropriate. The unit will have the ability to sense when conditions are favorable to allow the air to by-pass.
- .18 Dampers (Face and Bypass) shall be controlled by adjustable low and high limit temperature control.

- .2 Performance
  - .1 Energy Transfer
    - .1 The ERV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other.
  - .2 Passive Frost Control
    - .1 The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.
  - .3 Continuous Ventilation
    - .1 Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters or defrost cycles under normal operating conditions.
  - .4 Laminar Flow
    - .1 Airflow through the ERV core shall be laminar over the products entire operating airflow range, avoiding deposition of particulates on the interior of the energy exchange plate material.

### **PART 3 EXECUTION**

#### **3.1 UNIT LOCATION**

- .1 Locate, orient, and connect ductwork per AMCA, ASHRAE, and SMACNA guidelines. Provide service clearances as indicated on the plans. Locate units as indicated.
- .2 Provide a poured concrete equipment pad for all floor mounted units. The pad thickness to be 4" and floor plan dimensions to be determined based on the unit selected. Provide a structurally suitable support for the base of any wall mounted or hung units.

#### **3.2 VIBRATION ISOLATION**

- .1 Provide spring type isolators appropriately sized for corner weights of the specific unit.
- .2 Provide flexible duct connections at unit duct flanges.

#### **3.3 DUCT DESIGN**

- .1 All ductwork shall be designed, constructed, supported and sealed in accordance with SMACNA HVAC Duct Construction Standards and pressure classifications.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3 Section 01 78 00 – Closeout Submittals.
- .4 Section 23 33 00 – Air Duct Accessories.
- .5 Section 23 33 15 – Dampers - Operating.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA B52 Mechanical Refrigeration Code.  
CAN/CSA-C656, Performance Standard for Split-System Central Air-Conditioners and Heat Pumps.
- .2 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
- .3 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
  - .1 ANSI/ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .4 Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.
- .5 Federal Halocarbon Regulations 2003 (FHR2003) and Amendments

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate following: fan, fan curves showing point of operation, motor drive, bearings, filters, mixing box, dampers, VAV, coil, include performance data.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include following: fan, bearings, motor, damper, VAV control, air volume, total cooling, sensible cooling, EDB, EWB, OAT.



## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .4 Divert unused paint material from landfill to official hazardous material collections site approved by Departmental Representative.
- .5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

## **1.6 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide list of individual manufacturer's recommended spare parts for equipment together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

## **Part 2 PRODUCTS**

### **2.1 OUTDOOR CONDENSING UNITS**

- .1 General
  - .1 The outdoor unit, indoor units, and controls shall be the product of one manufacturer. The outdoor units shall be equipped with circuit boards that interface to the control system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped, wired, and run tested at the factory.
  - .2 The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.
  - .3 The system shall provide cooling only for the zones required. Low ambient operation to -25 degrees Celsius required.
  - .4 Outdoor unit shall have a sound rating no higher than 60 dB(A).
  - .5 Both refrigerant lines from the outdoor unit to indoor units shall be individually insulated.

- .6 The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
- .7 The outdoor unit shall have a high-pressure safety switch, over-current protection and DC bus protection.
- .8 The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have a total refrigerant tubing length of 984 feet. The greatest length is not to exceed 492 feet between the outdoor unit and the indoor units without the need for line size changes or traps.
- .9 The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- .2 Unit Cabinet – The casing(s) shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.
- .3 Fan
  - .1 The outdoor units shall be furnished with one direct drive, inverter driven, variable speed propeller type fan.
  - .2 The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
  - .3 The fan motor shall be mounted for quiet operation.
  - .4 The fan shall be provided with a raised guard to prevent contact with moving parts.
  - .5 The outdoor unit shall have vertical discharge airflow.
- .4 Refrigerant
  - .1 R410A refrigerant shall be required for all systems.
- .5 Coil
  - .1 The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
  - .2 The coil fins shall have a factory applied corrosion resistant finish
  - .3 The outdoor coil fins shall have optional special finish for corrosion protection.
  - .4 The coil shall be protected with an integral metal guard.
  - .5 Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
- .6 Compressor
  - .1 Outdoor units shall be equipped with inverter driven scroll hermetic compressor(s) only.
  - .2 All compressors shall have flash injection for effective low outdoor temperature heating performance.
  - .3 A crankcase heater(s) shall be factory mounted on the compressor(s).
  - .4 Each compressor shall be capable of modulation down to 16% of rated capacity.
  - .5 The compressor shall be equipped with an internal thermal overload.
  - .6 The compressor shall be mounted to avoid the transmission of vibration.

- .7 Electrical
  - .1 The outdoor unit electrical power shall be 208/230 volts, 3 phase, 60 hertz.
  - .2 The outdoor unit shall be controlled by integral microprocessors.
  - .3 The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair non-polar shielded cable to provide total integration of the system.
- .8 Performance: as indicated

## 2.2 INDOOR UNITS – WALL MOUNT TYPE

- .1 General – The wall-mounted indoor evaporator unit section shall be a slim design and shall have a modulating linear expansion device.
- .2 Indoor Unit – The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- .3 Unit Cabinet
  - .1 The casing shall have a white finish.
  - .2 Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
  - .3 There shall be a separate back plate which secures the unit firmly to the wall.
- .4 Fan
  - .1 The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
  - .2 The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
  - .3 A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
  - .4 A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- .5 Filter – Return air shall be filtered by means of an easily removable, washable filter.
- .6 Coil
  - .1 The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
  - .2 The tubing shall have inner grooves for high efficiency heat exchange.
  - .3 All tube joints shall be brazed with phos-copper or silver alloy.
  - .4 The coils shall be pressure tested at the factory.

- .5 A condensate pan and drain shall be provided under the coil.
- .6 Both refrigerant lines to the indoor units shall be insulated.
- .7 Electrical
  - .1 The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
- .8 Controls – include digital wall mounted controller for each zone with further system requirements as detailed in this section
- .9 Performance: as indicated

### **2.3 CONTROL SYSTEM**

- .1 The control system shall be provided by the split system manufacturer and be capable of controlling the systems and zones indicated on the drawings on an individual basis. Controllers shall be capable of setpoint adjust, night setback, and scheduling.

## **Part 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install units in accordance with manufacturer's instructions and as indicated.
- .2 Make all piping, power, and control connections as required.
- .3 Install refrigerant lines in accordance with manufacturer's instructions and associated sections of this specification. Provide all refrigerant fittings, joints, headers, devices as required by manufacturer for a complete working installation.
- .4 The design basis is for a two-pipe system multiple indoor unit heat pumps system. Heat pump systems meeting the technical and performance requirements listed herein but using other configurations, three-pipe systems, or other designs shall be at no additional cost.
- .5 Ensure adequate clearance for servicing and maintenance.

### **3.2 COMMISSIONING**

- .1 Commission in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements one day per unit for startup and one day for commissioning.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SECTION INCLUDES**

- .1      Supply and install a DDC Control System for equipment and systems provided by mechanical trades.
- .2      All hardware, devices, provide sensors, safety devices, operator interfaces, interconnecting cables, panels and all other materials for complete working systems.
- .3      Provide all labour including installation, programming, start-up, training and commissioning.
- .4      Coordinate all wiring with Division 26.
- .5      The contractor is to ensure that all related work is co-ordinated among all specification sections, as well as between other Divisions, and that the tender price includes all related work.

**1.2**            **RELATED WORK**

- .1      Division 26 Contractor provides line voltage components and other 120 volt control components other than damper motors and actuators, unless specifically noted otherwise or unless provided as part of manufactured equipment supplied by Mechanical.

**1.3**            **SUBMITTALS**

- .1      Submit shop drawings and product data.
- .2      Indicate on shop drawings, complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Include sizing as requested.
- .3      Provide product data on each control component.
- .4      At completion of work, make detailed check out of automatic control system and submit written report.

**1.4**            **WARRANTY**

- .1      To include labour, materials, travel costs, software costs and all other costs for a period of 12 months after final acceptance. To repair defects or failures.
- .2      A single warranty date will be established for entire system starting when work is turned over to the Departmental Representative.
- .3      Response time is to be within 40 hours for each call.

**1.5**            **OWNERSHIP**

- .1      Project developed software is the property of the Owner.

**1.6**            **SYSTEM DESCRIPTION**

- .1      Refer to control schematics, sequences of operation and related requirements of this specification 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 summaries and/or shown on the control drawings.
  - .3 Operator Work Station (OWS)
  - .4 Data communications equipment necessary to affect 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 prior to installation.
  - .3 Location of controllers as reviewed by Departmental Representative prior to installation.
  - .4 Provide utility and emergency power to EMCS.
  - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
  - .1 Provide English interface to system through operator selectable access codes.
  - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
  - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
  - .4 System manager software: include in English 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:
  - .1 Input and output commands and messages from operator-initiated functions and 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 English at specified OWS. Point name expansions in English.

- .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.
- .6 The network design to be a fully distributed network, with each primary system having its own locally mounted dedicated controller. Any failure in the network shall **not** in any way affect the control of these primary systems. Connecting hardware points from one system to more than one controller is not acceptable. Any points associated with a system are to be connected to one dedicated controller. Each dedicated controller to have a locally mounted control and display device to allow the operator to view and adjust any point on the controller.
- .7 Division 25 contractor provides all wiring associated with the EMCS communication network as well as all control wiring and conduit associated with the EMCS at 50 volts or less. Wire and conduit above 50 volts by Division 26 contractor.
- .8 BACnet compliance: full compliance to the BACnet standard (ANSA/ASHRAE) 135, BACnet – A Data communication Protocol for Building Automation and Control Networks is mandatory. Down to the field device level, the EMCS system must meet BACnet standards for system architecture and administration, and use open communication protocols and user friendly programming and graphics. Install the EMCS to communicate at the supervisory layer to the WAN using the BACnet TCP/IP protocol implemented on Ethernet.
- .9 The EMCS system for this facility to be accessible by designated personnel via the WAN for monitoring and programming purposes. The EMCS contractor to provide all the required hardware, software, gateways, etc. needed to permit connection of the EMCS to the WAN. This shall include all hardware, software, programming, start-up and commissioning required. The contractor to supply and install all the required hardware and software on the WAN file server to allow for this remote operation monitoring and programming to take place. The contractor to supply and install all the required hardware and software on the operator workstation(s) at location designated by Departmental Representative.

## **1.7 EMCS LAN DESIGN REQUIREMENTS**

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529, TIA/EIA-568, CSA T530 and TIA/EIA-569-A.
  - .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 Data communication network to included, but not limited to:
  - .1 EMCS-LAN.
  - .2 Modems.
  - .3 Network interface cards.
  - .4 Network management hardware and software.
  - .5 Network components necessary for complete network.
- .3 EMCS Local Area Network (EMCS-LAN).

- .1 High Speed, high performance, local area network over MS/TP with 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 be: BACnet Protocol
  - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
  - .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
  - .5 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.
  - .6 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.
  - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .4 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.
- .5 Network Medium: twisted cable, shielded twisted cable, or fibre optic cable compatible with network protocol to be used within buildings.

## **PART 2**      **PRODUCTS**

### **2.1**      **GENERAL**

- .1 All controllers are to be BACnet compliant.
- .2 Provide minimum 15 minute UPS for each DDC panel.
- .3 Control devices of each category to be of same type and manufacturer.
- .4 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
- .5 Operating conditions: 0 - 32 °C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .6 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .7 Transmitters to be unaffected by external transmitters (eg. walkie talkies).
- .8 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .9 Outdoor installations: use weatherproof construction in CSA 4X enclosures.



## 2.2 SOLID STATE RELAYS

- .1 Requirements:
  - .1 CSA approved.
  - .2 Suitable to the application as recommended by manufacturer.
  - .3 Voltage range: 75-265 VAC
  - .4 Panel mounting.
  - .5 Suitable for AC or DC loads.
  - .6 Output surge absorbing element for inductive on/off loads.
  - .7 Input capacitor/resistor circuit for pulse noise absorption.
  - .8 For input inductive noise use twisted-pair wires for electromagnetic noise and shielded cable for static noise.

## 2.3 CURRENT TRANSMITTERS

- .1 AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 0-5 vdc two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A and 200 A full scale, internal zero and span adjustment, and  $\pm 1\%$  full scale accuracy at 500 ohm maximum burden.
- .2 Transmitter shall meet or exceed ANSI/ISA 50.00.01 Compatibility of Analog Signals for Electronic Industrial. Process Instruments requirements and shall be UL/CSA recognized.
- .3 Unit shall be split core type for clamp-on installation.

## 2.4 CURRENT SENSING RELAYS

- .1 Requirements:
  - .1 Complete with metering transformer ranged to match load, plug-in base and shorting shunt to protect current transformer when relay is removed from socket.
  - .2 Suitable for single or 3 phase metering into single relay.
  - .3 To have adjustable latch level, adjustable delay on latch and minimum differential of 10 % of latch setting between latch level and release level.
  - .4 3-Phase application: provide for discrimination between phases.
  - .5 To have adjustable latch level to allow detection of worst case selection. To be powered from control circuit of motor starter being metered. Relay and base to be mounted in adjacent auxiliary cabinet only if control circuit power to be brought into auxiliary cabinet. Adjustments to be acceptable from auxiliary cabinet.
  - .6 Relay contacts: capable of handling 10 amps at 240 V AC.

## 2.5 CURRENT TRANSFORMERS

- .1 AC current transformers shall be UL/CSA recognized and completely encased (except for terminals) in approved plastic materials.
- .2 Transformers shall be available in various current ratios and shall be selected for + 1% accuracy at 5 A full scale output.
- .3 Transformers shall be split-core type for installation on new or existing wiring.

## **2.6 VOLTAGE TRANSFORMERS**

- .1 AC voltage transformers shall be UL/CSA recognized, 600 VAC rated, complete with built-in fuse protection.
- .2 Transformers shall be suitable for ambient temperatures of 4 to 55 degrees C (40 to 130 degrees F) and shall provide  $\pm 0.5\%$  accuracy at 24 VAC and a 5 VA load.
- .3 Windings (except for terminals) shall be completely enclosed with metal or plastic material.

## **2.7 CONTROL PANELS**

- .1 Control cabinets shall be fully enclosed NEMA construction with hinged door, key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels suitable for wet environment.
- .2 Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

## **2.8 ELECTRONIC CONTROL DAMPER OPERATORS**

- .1 Requirements
  - .1 Push-pull proportional type as indicated.
  - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated or as required by sequence.
  - .3 Operator: size to control dampers against maximum pressure or dynamic closing pressure (whichever is greater).
  - .4 Power requirements: 5 VA maximum at 24 V AC.
  - .5 Operating range: 4-20 mA, 0-10 V DC, 2-10 V DC.

## **2.9 WIRING**

- .1 Provide all wiring under 50 volts.
- .2 Install in conduit to all requirements of Division 26.
- .3 Non-Shielded Control Cable: type LVT to CSA C22.2 No. 35 (Canadian Electrical Code), with PVC insulation and jacket and #18 AWG solid copper conductors.
- .4 Shielded Cable: individually shielded, multiple twisted pair electronic cable with polyethylene insulation rated 300 volts, PVC jacket and stranded, tinned copper conductors, #22 AWG minimum.
- .5 Conduit: galvanized steel electrical metallic tubing to CSA C22.2 No. 83 (Canadian Electrical Code), with set-screw type fittings and conduit bodies to CSA C22.2 No. 18 (Canadian Electrical Code).
- .6 Provide all other materials as required for complete working system.

## 2.10 TEMPERATURE SENSORS

- .1 General: to be resistance or thermocouple type to following requirements:
  - .1 Thermistors 10 K ohm,  $\pm 0.2^{\circ}$  C accuracy, less than  $0.1^{\circ}$  C drift over 10 year span. Power supply 5 V dc, 10-35 Vdc, 24 Vac..
  - .2 RTD's: 1000 ohm at  $0^{\circ}$  C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm $^{\circ}$ C.
  - .3 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.
- .2 Sensors:
  - .1 Room type: wall mounting, in slotted type covers, LCD display  $^{\circ}$ C or  $^{\circ}$ F, with guard as indicated. Dual set point momentary push button, override switch.
  - .2 Room type for VAV boxes: as for room type, above. Include setpoint adjustment, local indication, push button override for night set back function.
  - .3 General purpose duct type: suitable for insertion into ducts at any angle, insertion length 460 mm.
  - .4 Averaging duct type: continuous filament with minimum immersion length 6000 mm. Bend probe at field installation time to 100 mm radius at any point along probe without degradation of performance.
  - .5 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in CSA 4X enclosure.

## 2.11 GARAGE GAS DETECTION SYSTEMS

- .1 The garage gas detection system shall consist of multiple gas detectors for carbon monoxide and nitrogen dioxide hazards as shown on the drawings.
- .2 The system shall include a central wall mounted gas detection control panel for the annunciation of gas hazards detected by the wired sensors, with relays for effective response to the hazards present (fan start, damper open, alarm to EMCS, etc).
- .3 The relays shall initiate corresponding alarms and ventilation systems as required.
- .4 1<sup>st</sup> stage gas alarm shall open dampers and start corresponding fans. On further rise in gas concentrations, 2<sup>nd</sup> stage shall initiate alarm strobes and horns for evacuation.
- .5 Gas detection system shall have BACnet interface for communication with building EMCS.
- .6 Provide all sensors, wiring, devices, programming, and commissioning for a complete working system.
- .7 Wire to and integrate with Building Control System as shown on drawings.

## 2.12 POWER SUPPLIES AND LINE FILTERING

- .1 Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service as per CEC requirements. Limit connected load to 80% of rated capacity.

- .1 DC power supply output shall match output current and voltage requirements. Unit shall be full wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Reactors shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Units shall have built-in over-voltage and over-current voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure:
  - .1 Unit shall operate between 0 degrees C and 50 degrees C. FM/RF shall meet FCC Class B and VDE 0871 for class B and MIL-STD 810C for shock and vibration.
  - .2 Line voltage units shall be UL recognized and CSA approved.

## **2.13 MISCELLANEOUS**

- .1 Provide all other devices, equipment, software, transformers, relays for complete working system.
- .2 Provide CSA Certification.

## **PART 3 EXECUTION**

### **3.1 CONDUIT**

- .1 Install conduit for all wiring.

### **3.2 INSTALLATION**

- .1 Check and verify location of exposed control sensors with plans and rooms details before installation. Mount devices 1400 mm above floor.
- .2 Install devices where indicated.
- .3 Locate controllers as required and where indicated on the drawings.
- .4 Install field control devices, conduit and wire in accordance with manufacturers recommended methods, procedures and instructions. Wiring and conduit above 50 volts by electrical Division. Coordinate requirements with Electrical Contactor.
- .5 Install wall mounted devices on plywood panel properly attached to wall.

### **3.3 SEQUENCE OF OPERATION**

- .1 Heat Recovery Ventilators
  - .1 The HRV supply fan and exhaust fan shall operate on a preset daily schedule as determined during commissioning. When the unit is off, the outside air damper and exhaust air damper shall be closed and the heating coil shall be off. All temperatures and humidity sensors shall continue to monitor, but the high and low limits shall not alarm.
  - .2 To start the system, the DDC controller shall command the system on. The outside air damper shall open. When the outside air damper end switch is closed, the supply fan shall start. The exhaust air damper shall open. When the exhaust air damper end switch is closed, the exhaust fan shall start.

- .3 Should the supply or exhaust fans current sensors fail to prove proper operation within a suitable time period after a start command (initially set at 60 seconds) an alarm signal shall be raised.
  - .4 For temperature control in heating mode, the DDC controller shall modulate the electric heating coil output to maintain supply temperature setpoint. Supply temperature setpoint shall be reset based on an analysis of zone heating/cooling demand.
  - .5 Both filter bank status shall be monitored by the DDC system via differential pressure switches. An alarm signal to change filters shall be raised at a set differential pressure (To be determined on site during air balancing).
- .2 Room Temperature Control
- .1 Variable Refrigerant Flow (VRF) Systems
    - .1 In rooms served by the VRF systems, heating/cooling control will be by the system's integral control system specified in Section 23 81 29, with BACnet integration in addition. The VRF system central controller shall determine whether the system is in heating or cooling priority based on outdoor air temperature and zone demand.
    - .2 For indoor units in cooling mode, on a call for space cooling, the room controller shall command on the associated indoor unit in cooling mode to maintain space temperature for the corresponding space.
    - .3 For indoor units in heating mode, on a call for space heating, the room controller shall command on the associated indoor unit in heating mode to maintain space temperature for the corresponding space. Should supplemental heat be required during normal operation or the VRF system is locked out due to low outdoor ambient conditions, the room controller shall send a signal to the electric baseboard heat relay to provide supplemental heat.
    - .4 Space temperatures shall be set back during unoccupied periods.
    - .5 The VRF system shall be integrated as specified below to permit remote read and write access to space setpoints and other system information. Coordinate points integration with VRF system supplier.
- .3 Garage Gas Detection
- .1 On first stage alarm (gas concentration level to be confirmed during commissioning) from the garage gas detection system, intake/exhaust dampers shall open, exhaust fan shall start, and alarm notification shall be sent to DDC system.
  - .2 On second stage alarm from the garage gas detection system (gas concentration level to be confirmed during commissioning), alarm strobes and horn shall be initiated for evacuation.
  - .3 When gas concentration returns to acceptable levels, alarm horn/strobe shall stop, and exhaust system (fan/dampers) shall turn off in reverse sequence.

### **3.4 DDC SYSTEM INTEGRATION**

- .1 The DDC system shall provide "single seat" integration of the entire facility using BACNet protocols.

.2 Systems and equipment to be integrated include, but are not necessarily limited to the following:

.1 Variable Refrigerant Flow (VRF) HVAC Systems – Section 23 81 29

.3 Integration shall be object based where specified in the referenced sections. Otherwise, integration shall be achieved as discrete binary points.

.4 Provide suitable explanatory graphics and associated point mapping as required.

### **3.5 INPUT/OUTPUT POINT SUMMARY TABLE**

.1 The contractor shall prepare an input/output table at the shop drawings stage summarizing the Input/Output (I/O) points for the various systems as outlined within the EMCS specifications and control schematic drawings. All points and field devices required to accomplish the specified sequence of operation shall be provided.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **GENERAL**

- .1      This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1, Division 23, Division 27 and Division 28.

**1.2**            **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
  - .2      CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

**1.3**            **CARE, OPERATION AND START-UP**

- .1      Instruct Departmental Representative and operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .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      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.
- .4      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 all aspects of its care and operation.

**1.4**            **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. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

## 1.5 SUBMITTALS

- .1 Where specifically requested, submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, 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 coordinated 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 Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.
  - .2 Submit test results of installed electrical systems and instrumentation.
  - .3 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
  - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .6 Manufacturer's Field Reports: submit to Departmental Representative within 7 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
- .7 Single Line Electrical Diagrams
  - .1 Provide single line electrical diagrams in glazed frames as follows:
    - .1 Electrical distribution system: locate in all electrical rooms and generator room.
    - .2 Provide fire alarm riser diagram, plan and zoning of building in glazed frame at fire alarm control panel and annunciator.
    - .3 Drawings: 600 x 600 mm minimum size.
- .8 All submittals shall be in standard electronic PDF format. Refer to 01 33 00 – Submittal Procedures for details.
- .9 Shop drawings:
  - .1 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or materials.
  - .2 Where applicable, indicate wiring, single line and schematic diagrams.
  - .3 Include wiring drawings or diagrams showing interconnection with work of other sections.
  - .4 Each shop drawing will be stamped and signed by the Contractor before submitting, stating that he has checked the drawings against the requirements as



- called for in the Contract Documents and also in the case where the equipment is attached to or connects to other equipment, that is has been properly coordinated with this equipment, whether supplied under Division 26 or under other Divisions.
- .5 Each shop drawing for non-catalogue items shall be prepared specifically for this project. If brochures are submitted for catalogue items, the brochures shall be marked precisely indicating the item or items to be supplied.
  - .6 Work shall not be proceeded with on any of the equipment until final review of shop drawings received by the Contractor.
  - .7 Note: Shop drawing review is for general compliance with Contract Documents. No responsibility is assumed by the Engineer for correctness of dimensions or details. Corrections or comments, or lack thereof, made on the shop drawings during the Engineer's review does not relieve the Contractor from compliance with the requirements of the drawings and specifications.
  - .8 If changes are required, notify Engineer of these changes before they are made.
- .10 Operation and Maintenance Data:
- .1 Provide operation and maintenance data for incorporation into operation and maintenance manuals. Manuals shall be 3-ring binders and shall be supplied in quantities to Section 01 78 00.
  - .2 Include in operations and maintenance data:
    - .1 Details of design elements, construction features, component function and maintenance requirements to permit effective start-up operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
    - .2 Technical data, product data, supplemented by bulletins, exploded views, technical description of items and part lists. Advertising or sales literature not acceptable.
    - .3 Wiring and schematic diagrams and performance curves.
    - .4 Names and addresses of local suppliers for items included in maintenance manuals.
    - .5 Copy of reviewed shop drawings.
- .11 As-Built Drawings – Submit in accordance with 01 33 00 – Submittal Procedures.

## **1.6 PERMITS, FEES AND INSPECTION**

- .1 Submit to Electrical Inspection Division and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Departmental Representative will provide drawings and specifications required by Electrical Inspection Division and Supply Authority at no cost.
- .4 Notify Departmental Representative of changes required by Electrical Inspection Division prior to making changes.

- .5 Furnish Certificates of Acceptance from Electrical Inspection Division or authorities having jurisdiction on completion of work to Departmental Representative.

## **1.7 CO-ORDINATION**

- .1 Co-ordinate work with work of other divisions to avoid conflict.
- .2 Locate distribution systems, equipment, and materials to provide minimum interference and maximum usable space.
- .3 Locate all existing underground services and make all parties aware of their existence and location.
- .4 Where interference occurs, Departmental Representative must approve relocation of equipment and materials regardless of installation order.
- .5 Notwithstanding the review of shop drawings, this division may be required to relocate electrical equipment which interferes with the equipment of other trades, due to lack of co-ordination by this Division. The cost of this relocation shall be the responsibility of this Division. The Departmental Representative shall decide the extent of relocation required.

## **1.8 CUTTING AND PATCHING**

- .1 Inform all other divisions in time, concerning required openings. Where this requirement is not met, bear the cost of all cutting. Openings of 200 mm or smaller shall be the responsibility of Division 26. Openings larger than 200 mm shall be the responsibility of Division 1. Obtain written approval of Structural engineer before drilling any beams or floors.

## **1.9 PROTECTION**

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark all live parts "LIVE 120 VOLTS", or with appropriate voltage in English.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

## **1.10 RECORD DRAWINGS**

- .1 Obtain and pay for three sets of white prints. As the job progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times and present for scrutiny at each job meeting.
- .2 Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run in relation to the structure and building.

- .3 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.
- .4 Submit record drawings within 30 days prior to start of commissioning.
- .5 Transfer As-Built information to electronic AutoCAD format prior to submitting for review.

#### **1.11 INSPECTION OF WORK**

- .1 The Departmental Representative will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of his work in conformity with the construction documents and with the requirements of the inspection authority.

#### **1.12 SCHEDULING OF WORK**

- .1 Work shall be scheduled in phases as per other divisions of the architectural specifications.
- .2 Become familiar with the phasing requirements for the work and comply with these conditions.
- .3 No additional monies will be paid for contractor's requirement to comply with work phasing conditions.

#### **1.13 DELIVERY, STORAGE AND HANDLING**

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

#### **1.14 SYSTEM START-UP**

- .1 Instruct Departmental Representative and operating personnel 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.

#### **1.15 WASTE MANAGEMENT & DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Division 01.

- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal: paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring and metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Place materials defined as hazardous or toxic waste in designated containers.
- .6 Ensure emptied containers are sealed and stored safely for disposal.
- .7 Unused materials must not be disposed of into sewer system, streams, lakes, onto ground or in other locations, where it will pose health or environmental hazard.
- .8 Do not dispose of preservative treated wood through incineration. Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Departmental Representative.
- .9 Divert unused batteries and antifreeze to appropriate recycling facilities as approved by Departmental Representative.
- .10 Dispose of fluorescent lamps and PCB ballasts in accordance with all Provincial and Federal Regulations.

#### **1.16 EQUIPMENT SUPPORTS AND HOUSEKEEPING PADS**

- .1 Equipment supports supplied by equipment manufacturer are specified elsewhere in Division 26.
- .2 Fabricate equipment supports not supplied by equipment manufacturer from structural grade steel meeting requirements of Division 5. Submit structural calculations with shop drawings. Ensure that supports meet the requirements of the National Building Code.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm high and 50 mm larger than equipment dimensions all around. Concrete is specified in Division 3.

#### **1.17 ANCHOR BOLTS AND TEMPLATES**

- .1 Supply anchor bolts and templates for installation by other divisions.

#### **1.18 ACCESS DOORS**

- .1 Supply access doors for concealed electrical equipment to allow operation, inspection, adjusting and servicing.

- .2 Use flush mounted 600 x 600 mm for body entry and 300 x 300 mm for hand entry unless otherwise noted. Doors to open 180, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
  - .1 Use stainless steel with brushed satin or polished finish in special areas such as tiled or marble surfaces and as directed by Departmental Representative.
  - .2 In remaining areas, use prime coated steel.
  - .3 Use ULC rated access doors in fire rated walls and ceilings.
- .4 Installation:
  - .1 Locate so that concealed items are accessible.
  - .2 Locate so that hand or body entry (as applicable) is achieved.
  - .3 Installation is specified in applicable sections.

## **PART 2**

### Products

### **2.1 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings, where applicable.
- .2 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 25 and shown on mechanical drawings. Division 25 – EMCS Controls Contractor is responsible for all conduit, wiring and connections below 50V which are related to control systems in Division 25 and shall comply with the requirements of Division 26 for standard of quality.

### **2.2 MATERIALS AND EQUIPMENT**

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Division.
- .3 Factory assemble control panels and component assemblies.

### **2.3 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 to EEMAC Y1-1.
  - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

## 2.4 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department and Departmental Representative.
- .2 Porcelain enamel decal signs, minimum size 175 x 250 mm.
- .3 Install adhesive backed polyester arc flash hazard labels on all major electrical components including the service entrance switchboard, panelboards, disconnects, splitters and master control centers/starters. Labels to measure 150 mm wide x 90 mm high (minimum) reading "Danger Arc Flash and Shock Hazard Follow Requirements in CSA Z462".

## 2.5 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

## 2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: Lamicoid 3 mm thick plastic engraving sheet, black white face, black white 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:
  - .1 Embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wordings on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate and label.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system name and voltage characteristics.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system name and voltage.

- .9 Transformers: indicate capacity, primary and secondary voltages and transformer number.
- .10 Panelboards: indicate name, voltage, capacity and upstream panel serving mains.

## 2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1, Canadian Electrical Code.
- .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.

<u>Conduit System</u>	<u>Prime Color</u>	<u>Auxiliary Color</u>
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

## 2.9 EXAMINATION OF OTHER WORK

- .1 This Division requires the examination of the material and work for all other Divisions under which the work of this Section depends for proper completion. Any defect in work, levels or materials shall be reported to the Departmental Representative. The work of this Division shall not commence until such defects have been corrected. This also applied to existing work installed under other Contracts.

## 2.10 CUTTING, PATCHING, SLEEVES, AND PLATES

- .1 All drilling for hangers, rod, inserts and work of similar nature shall be done by Division 26.

- .2 Have core drilled openings installed in foundation walls to accommodate the work of this Division. Seal conduit through the cored opening using industrial duty round compression seals sized to suit diameter of conduit.

## **2.11 HANGERS AND EQUIPMENT SUPPORTS**

- .1 All equipment provided under the Electrical Division shall be complete with all necessary supports and hangers required for a safe and workmanlike installation and to avoid strain on conduit, etc. Auxiliary supports where required shall be provided under this Division.
- .2 Hammer driven hanger supports, eg. staples, nails, etc. will not be used.
- .3 Expansion bolts, inserted after concrete has been poured are acceptable.
- .4 Paint all hangers, eg. U-bolts, trapeze hangers, etc. BEFORE INSTALLATION.
- .5 Wire is not an acceptable conduit support.

## **2.12 TESTING, ACCEPTANCE AND GUARANTEE**

- .1 The work of this Contract shall be tested and installed and any defects in operation shall be remedied immediately. Tests required by local authorities shall be the responsibility of the Contractor. When the work is completed, it shall be tested in its entirety and shall be in good working order before the Government of Canada's Certificate of Acceptance shall be issued.
- .2 A written guarantee shall be supplied to the Departmental Representative by the Contractor covering the prompt making good of any and all defects in material and workmanship for the period of one (1) year from the date of acceptance and the making good of any such defects shall be completely the responsibility of the Contractor.

## **PART 3 EXECUTION**

### **3.1 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

### **3.2 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 27 26 – Wiring Devices.
- .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. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

### **3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete. 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 to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

### **3.4 SPRINKLERPROOF EQUIPMENT**

- .1 Equipment located in sprinklered rooms shall meet the requirements set out by the Inspection Authority and as listed below:
  - .1 Gaskets on doors and drip shields on:
    - .1 Free-standing switchboards, transformers, panelboards, motor starters, capacitors, splitter, troughs, and disconnect switches; and
    - .2 All "Systems" equipment and cabinets, e.g., fire alarm, telephone, data, etc., installed below the level of the sprinkler heads.
  - .2 Louvers facing outwards and downwards where openings are required for heat dissipation. (Expanded metal screening is not acceptable.)
  - .3 CSA certified sealing rings for rigid steel galvanized conduit and CSA certified raintight connectors for steel galvanized electrical metallic tubing (EMT) where conduits enter the top or sides of enclosures.

### **3.5 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 at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
    - .2 Above top of continuous baseboard heater: 200mm.
    - .3 Above top of counters or counter splash backs: 175 mm.
    - .4 In mechanical rooms: 1400 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 400 mm.
  - .5 Wall mounted telephone and interphone outlets: 1400 mm.

- .6 Fire alarm stations: 1100 mm.
- .7 Fire alarm bells, horns and strobe lights: 2300 mm.
- .8 Television outlets: 2700 mm AFF for wall mounted TVs.
- .9 Wall mounted speakers: 2400 mm.
- .10 Clocks: 2400 mm.
- .11 Door bell pushbuttons: 1200 mm.
- .12 Exit lights: 2400 mm.
- .13 Emergency lighting heads: 2400 mm.
- .14 Exterior CCTV: 4500 mm above finished grade or as high as possible.
- .15 Motion Sensor: 2150 mm.
- .16 Keypad: 1522 mm.
- .17 Card Reader: 1200 mm

### **3.6 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- .2 All breakers feeding life safety loads (i.e. emergency generator, transfer switch, fire alarm, emergency lights, exit lights, smoke exhaust, firefighters' elevator, etc.) to be fully coordinated.

### **3.7 FIELD QUALITY CONTROL**

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks – the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Code 1 Electrical Contractor License as issued by the Province of Newfoundland and Labrador.
- .3 Perform tests in Accordance with this section as noted.
- .4 Load Balance:
  - .1 Measure phase current to panelboard 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 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

- .5 Conduct and pay for following tests:
  - .1 Power generation and 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 operations of systems where applicable.
  - .5 Systems: fire alarm system, communications, security, cameras, electronic metering.
- .6 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .7 Insulation resistance testing.
  - .1 Megger and record circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger and record 350 – 600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing and record value.
- .8 Carry out tests in presence of Departmental Representative.
- .9 Provide instruments, meters, equipment and personnel required to conduct tests during and conclusion of project.
- .10 Submit test results for Departmental Representative's review and include in Commissioning Manuals.

### **3.8 PROTECTION OF OPENINGS**

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

### **3.9 PREPARATION FOR FIRESTOPPING**

- .1 Prepare the space between conduits and adjacent sleeve or fire separation for the use of fire proofing material.
- .2 Where conduits pass through fire rated walls or ceilings, sleeve with steel conduit and prepare the opening for fire and smoke sealing and seal with proper fire and smoke rated material.
- .3 Where cables pass through fire rated walls or ceilings, provide Cable Management Sleeves in accordance with Section 07 84 13 – Penetration Firestopping.
- .4 In electrical and communication rooms where floor openings are provided for vertical conduit and Mineral Insulated cable risers, co-ordinate the layout and spacing of conduits to ensure the effectiveness of fire stopping prior to routing any conduits. In all

cases provide spare 27 mm conduit stubs sealed top and bottom to maximize the use of the opening prior to the installation of fire and smoke stopping material.

- .5 Where conduits pass through fire or smoke rated partitions, install a junction box in the conduit just prior to exiting the space. Use this junction box to install smoke stopping material.

### **3.10 VAPOUR BARRIER PENETRATIONS**

- .1 Outlet and junction boxes installed in walls equipped with a vapour barrier to be surrounded with a moisture resistant barrier or boxes are to be specifically designed for use in vapour barrier walls.

### **3.11 PAINTING**

- .1 Perform painting to requirements of Division 9.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Prime and touch up marred finished paintwork to match original.
- .4 Restore to new condition, finishes that have been damaged too extensively to be primed and touched up.

### **3.12 TRIAL USAGE**

- .1 Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 Lighting system.
  - .2 Power Distribution system.
  - .3 Communication systems.
  - .4 Security systems.
  - .5 Metering systems.
  - .6 Fire Alarm Systems.

### **3.13 TESTS**

- .1 Give 24 h written notice of date for tests. Conceal work only after testing and approval by Departmental Representative. Conduct tests in presence of Departmental Representative. Bear costs including re-testing and making good.
- .2 Equipment: test as specified in relevant sections.
- .3 Prior to tests, isolate all equipment or other parts that are not designed to withstand test pressures or test medium.

**3.14 CLEANING**

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- .3 Complete final cleaning of equipment and work area as acceptable to Departmental Representative.
- .4 At time of final cleaning, clean lighting, reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

**3.15 DRAWINGS, CHANGES, ACCESSIBILITY**

- .1 The drawings shall be considered to show the general character and scope of work and not the exact details of the installation.
- .2 The installation shall be complete with all supports and accessories required for a complete operative and satisfactory installation.
- .3 The location, arrangement and connection of equipment and materials as shown on the drawings represent a close approximation to the intent and requirements of the Contract.
- .4 The right is reserved by the Departmental Representative to make reasonable changes required to accommodate conditions arising during the progress of the work. Such changes shall be done at no extra cost to the Government of Canada unless the location, arrangement or connection is more than 3.0 m from that shown.
- .5 Actual location of existing services shall be verified in the field where necessary before work is commenced.
- .6 Changes and modifications necessary to ensure co-ordination and to avoid interference or conflicts with other trades, or to accommodate existing conditions, shall be made at no extra cost to the Government of Canada.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **SECTION INCLUDES**

- .1      Materials and installation for wire and box connectors.

**1.2**      **RELATED SECTIONS**

- .1      Section 26 05 00 – Common Work Results - Electrical.

**1.3**      **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2      CSA C22.2 No.65, Wire Connectors.
- .3      Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1      EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .4      National Electrical Manufacturers Association (NEMA)

**PART 2**      **PRODUCTS**

**2.1**      **MATERIALS**

- .1      Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2      Fixture type splicing connectors to: 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 stranded copper conductors.
  - .2      Clamp for copper bar.
  - .3      Stud clamp bolts.
  - .4      Bolts for copper bar.
  - .5      Sized for conductors and bars as indicated.
- .4      Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

**PART 3**      **- EXECUTION**

**3.1**            **INSTALLATION**

- .1      Remove insulation carefully from ends of conductors and:
  - .1      Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
  - .2      Install fixture type connectors and tighten. Replace insulating cap.
  - .3      Install bushing stud connectors in accordance with EEMAC 1Y-2.
  - .4      Apply coat of zinc joint compound on aluminum conductors prior to connector installation.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .2      Refer to drawings for wiring type required under different applications.

**1.2**            **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
  - .2      CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.
  - .3      CSA C22.1 – Canadian Electrical Code.
  - .4      ULC S139.
  - .5      CSA C22.2 No. 38,124,208
  - .6      UL 2196
  - .7      UL 44.
  - .8      National Building Code of Canada

**1.3**            **REGULATORY REQUIREMENTS**

- .1      Conform to requirements of Canadian Electrical Code, Part 1.
- .2      Conform to requirements of Fire Resistant Cables in the ULC Online Certification Directory and the Electrical Circuit Protective System Listing in the UL Fire Resistance Directory.
- .3      Furnish products Certified by CSA as suitable for the purpose specified.

**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 chemically cross-linked thermosetting polyethylene material rated RW90 and RWU90 as indicated. Provide RWU90 rated cable for underground wiring related to new service entrance feeders and site lighting circuits. RWU90 not required under interior floor slabs.
- .3      Copper conductors: size as indicated, with thermoplastic insulation type TWH rated at 600 V, typically used for insulated ground wires.



## **2.2            ARMOURED CABLES**

- .1        Conductors: insulated, copper, size as indicated.
- .2        Type: AC90.
- .3        Armour: interlocking type fabricated from aluminum strip.
- .4        Connectors: standard as required, complete with double split rings.

## **2.3            CONTROL CABLES**

- .1        Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
- .2        Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW -40°C polyethylene insulation with shielding of tape coated with paramagnetic material wire braid over each conductor and overall covering of PVC jacket.

# **PART 3            EXECUTION**

## **3.1            INSTALLATION OF BUILDING WIRES**

- .1        Install wiring as follows:
  - .1        In conduit systems in accordance with Section 26 05 34- Conduits, Fastenings and Fittings.
  - .2        In underground ducts in accordance with Section 26 05 43.01- Installation of Cables in Ducts.

## **3.2            INSTALLATION OF ARMOURED CABLES (AC-90)**

- .1        Group cables wherever possible.
- .2        Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .3        Use permitted only for work in movable partitions and vertical power supply drops to lighting fixtures.

## **3.3            INSTALLATION OF CONTROL CABLES**

- .1        Install control cables in conduit, and underground ducts as indicated.
- .2        Ground control cable shield.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 26 05 00 – Common Work Results - Electrical.
- .2      Section 27 05 26 – Grounding and Bonding for Communication System.
- .3      Grounding conductors for all distribution grounding to be insulated copper, uninsulated where in contact with earth.

**1.2**      **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
  - .1      ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

**PART 2**      **PRODUCTS**

**2.1**      **EQUIPMENT**

- .1      Clamps for grounding of conductor: size as indicated to electrically conductive underground water pipe.
- .2      Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.
- .3      Rod electrodes: copper clad steel 19 mm dia by 3 m long.
- .4      Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .5      Insulated grounding conductors: green, type TW.
- .6      Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .7      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, as required by local authority having jurisdiction.
  - .4      Thermit welded type conductor connectors, as indicated.
  - .5      Bonding jumpers, straps.
  - .6      Pressure wire connectors.

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**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION GENERAL**

- .1      Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run insulated copper 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 copper welding by thermit process.
- .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 by welding copper to steel.
- .11     Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12     Bond single conductor, metallic armoured cables to cabinet at supply end and load end.
- .13     Ground secondary service pedestals.

**3.2**            **ELECTRODES**

- .1      Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2      Install water meter shunt.
- .3      Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .4      Install rod electrodes and make grounding connections.
- .5      Bond separate, multiple electrodes together.
- .6      Use copper conductors for connections to electrodes as indicated on the drawings.

- .7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

### **3.3 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral of primary 600 V system and secondary 208 V system.

### **3.4 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, transformers, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators, distribution panels, and outdoor lighting.

### **3.5 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual insulated stranded copper connections in conduit size as required by code.

### **3.6 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
  - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
  - .2 Sound, fire alarm, intercommunication systems as indicated.
  - .3 Telecommunications Systems as per Section 27 05 26 – Grounding and Bonding for Communication System.

### **3.7 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results - 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.

**END OF SECTION**

**PART 1**      **GENERAL (NOT APPLICABLE)**

**PART 2**      **PRODUCTS**

**2.1**            **SUPPORT CHANNELS**

- .1            U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended or set in poured concrete walls and ceilings as required.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1            Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .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.
  - .4            Strap AC-90 cable at box location plus every 900 mm.
- .7            Suspended support systems.
  - .1            Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2            Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8            For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .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, wood blocking, plastic strap 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.
- .14 Provide required support where ceilings, etc. cannot support additional loads.
- .15 Paint all rods, angles, channels, etc. before installation.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 26 05 00 - Common Work Results – Electrical.

**1.2**      **SUBMITTALS**

- .1      Submit shop drawings and product data for cabinets.

**PART 2**      **PRODUCTS**

**2.1**      **SPLITTERS**

- .1      Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2      Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3      At least three spare terminals on each set of lugs in splitters less than 400 A.

**2.2**      **JUNCTION AND PULL BOXES**

- .1      Welded steel construction with screw-on flat covers for surface mounting.
- .2      Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

**2.3**      **CABINETS**

- .1      Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2      Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm fir plywood backboard for surface flush mounting.

**PART 3**      **EXECUTION**

**3.1**      **SPLITTER INSTALLATION**

- .1      Install splitters and mount plumb, true and square to the building lines.
- .2      Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

**3.3 IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name voltage and phase.

**END OF SECTION**



**PART 1**      **GENERAL**

**1.1**            **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CSA C22.1, Canadian Electrical Code, Part 1.

**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 for special devices.
- .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**            **SHEET STEEL OUTLET BOXES**

- .1      Electro-galvanized steel single and 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.
- .2      Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3      102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4      102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

**2.3**            **MASONRY BOXES**

- .1      Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

**2.4**            **CONCRETE BOXES**

- .1      Electro-glvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm conduit. Minimum size: 73 mm deep.

## **2.5 CONDUIT BOXES**

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

## **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 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.
- .5 Double split rings for AC-90 terminations.

## **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. Reducing washers are not allowed.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **REFERENCES**

- .1 Codes and standards referenced in this section refer to the latest edition thereof.
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and 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.

**1.2**      **SUBMITTALS**

- .1 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.
- .2 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.

**PART 2**      **PRODUCTS**

**2.1**      **CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2, FT-4 rated, Iplex Scepter or equal.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

## **2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. 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 1.5 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90°, 45 ° or 22.5 ° bends are required for 25 mm and larger conduits.
- .3 Ensure conduit bends other than factory "ells" are made with an approved bender. Making offsets and other bends by cutting and rejoining 90 degree bends are not permitted.
- .4 Connectors and couplings for EMT. Steel set-screw type, size as required. Compression type in damp or wet locations.

## **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.5 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 all conduit, conduit fittings and accessories in accordance with the latest edition of the Canadian Electrical Code in a manner that does not alter, change or violate any part of the installed system components or the C.S.A./UL certification of these components.
- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .3 Conceal conduits except in mechanical and electrical service rooms.
- .4 Surface mount conduits except in finished areas or as indicated.
- .5 Use epoxy coated conduit underground in corrosive areas and where exposed to exterior elements.
- .6 Use electrical metallic tubing (EMT) except in cast concrete.
- .7 Use rigid PVC conduit underground, buried in or under concrete slab on grade and in supported cast concrete slabs.
- .8 Use flexible metal conduit for connection to motors in dry areas connection to recessed lighting fixtures without a prewired outlet box connection to surface or recessed lighting fixtures work in movable metal partitions.
- .9 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .10 Use AC-90 for vertical power supply drops to light fixtures.
- .11 Minimum conduit size for lighting and power circuits: 21 mm. 16 mm conduit is acceptable for switch leg drops only where one two-wire circuit and ground is required.
- .12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Mechanically bend steel conduit over 21 mm dia.
- .14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .15 Install fish cord in empty conduits.
- .16 Run 2 - 27 mm spare conduits up to ceiling space and 2 - 27 mm spare conduits down to ceiling space from each flush panel. 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 flush concrete type box.
- .17 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .18 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. Install in centre one third of slab. Use rigid PVC conduit.
- .2 Protect conduits from damage where they stub out of concrete. Use rigid steel conduit for stub-up and adapt to in floor rigid PVC conduit.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 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 encased in 75 mm concrete envelope. 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**            **RELATED REQUIREMENTS**

- .1      Section 26 05 00 - Common Work Results – Electrical.
- .2      Section 26 05 28 - Grounding Secondary.

**1.2**            **REFERENCES**

- .1      Canadian Standards Association (CSA International)
  - .1      CAN/CSA C22.1 No.126.1, Metal Cable Tray Systems.
- .2      National Electrical Manufacturers Association (NEMA)
  - .1      NEMA VE 1, Metal Cable Tray Systems.
  - .2      NEMA VE 2, Cable Tray Installation Guidelines.

**1.3**            **ACTION AND INFORMATIONAL SUBMITTALS**

- .1      Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3      Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4      Identify types of cabletroughs used.
- .5      Show actual cabletrough installation details and suspension system.

**1.4**            **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**            **CABLETROUGH**

- .1      Wire mesh type, to CAN/CSA C22.2 No.126.1.
- .2      Trays: carbon steel wire, ASTM A 510, Grade 1008, wire welded, bent, and surface treated after manufacture. Electrodeposited zinc plating: ASTM B633, Type III, SC-1, sizes as indicated.
- .3      Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
  - .1      Radii on fittings: 300 mm minimum.
- .4      Barriers where different voltage systems are in same cabletrough.
- .5      Provide cable exit (drop out fitting) at each equipment enclosure.



- .6 Provide "long radius", radius shield or cable rollers for all 90° bends, Tees and crosses.
- .7 Ground cable trays with #6 AWG green insulated copper conductor attached to each tray section in accordance with CEC requirements.
- .8 Provide Cable Management Sleeves in accordance with Section 07 84 13 – Penetration Firestopping at firewall penetrations to allow for easy "re-penetration" of future cable installations.

## **2.2 SUPPORTS**

- .1 Provide splices, supports for a continuously grounded system as required.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install complete cabletrough system in accordance with NEMA VE 2.
- .2 Support cabletrough on both sides.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 26 05 00 - Common Work Results - Electrical.
- .2      Section 31 23 33.01 - Excavating, Trenching and Backfilling.

**1.2**      **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association, (CSA)
- .3      Insulated Cable Engineers Association, Inc. (ICEA)

**PART 2**      **PRODUCTS**

**2.1**      N/A

**PART 3**      **EXECUTION**

**3.1**      **CABLE INSTALLATION IN DUCTS**

- .1      Install cables as indicated in ducts.
  - .1      Do not pull spliced cables inside ducts.
- .2      Install multiple cables in duct simultaneously.
- .3      Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4      To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .5      Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .6      After installation of cables, seal duct ends with duct sealing compound.

**3.2**      **FIELD QUALITY CONTROL**

- .1      Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2      Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3      Check phase rotation and identify each phase conductor of each feeder.

- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests.
  - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
  - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests
  - .1 Ensure that terminations and accessory equipment are disconnected.
  - .2 Ground shields, ground wires, metallic armour and conductors not under test.
  - .3 High Potential (Hipot) Testing.
    - .1 Conduct hipot testing at 100 % of original factory test voltage in accordance with manufacturer's recommendations.
  - .4 Leakage Current Testing.
    - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
    - .2 Hold maximum voltage for specified time period by manufacturer.
    - .3 Record leakage current at each step.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test. Include results in Commissioning Manual.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 01 33 00 – Submittal Procedures.
- .2      Section 01 78 00 – Closeout Procedures.
- .3      Section 26 05 00 – Common Work Results - Electrical.

**PART 2**      **PRODUCTS**

**2.1**      **PHOTOELECTRIC LIGHTING CONTROL**

- .1      Wall mounting.
- .2      Capable of switching 1800 W of lighting at 120 V or 347 V as indicated.
- .3      Voltage variation: plus or minus 10%.
- .4      Temperature range: minus 40°C to plus 40°C.
- .5      Switching on lights at 1-5 lx.
- .6      Switching off lights at 6-15 lx.
- .7      Rated for 5000 operations.
- .8      Options:
  - .1      Twist-lock type receptacle.
  - .2      Sensitivity adjustment.
- .9      Switching time delay of 30 s.
- .10     Wall mounting bracket.
- .11     Colour coded leads: size 10 AWG, 460 mm long.

**PART 3**      **EXECUTION**

**3.1**      **INSTALLATION**

- .1      Install photoelectric controls in accordance with manufacturer's instructions.

**3.2**      **FIELD QUALITY CONTROL**

- .1      Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.

- .2 Actuate control unit in presence of Departmental Representative to demonstrate lighting circuits are controlled as designated.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      Section includes:
  - .1      LED dimming driver.

**1.2**            **REFERENCES**

- .1      International Electrotechnical Commission.
  - .1      (IEC) 801-2 Electrostatic Discharge Testing Standard.
  - .2      IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.
- .2      International Organization for Standardization (ISO) ([www.iso.ch](http://www.iso.ch)):
  - .1      9001 – Quality Management Systems.
- .3      Underwriters Laboratories, Inc. (UL):
  - .1      8750 – LED drivers

**1.3**            **DESCRIPTION**

- .1      LED dimming driver
  - .1      Digital (Low Voltage Controlled) Dimming Drivers.

**1.4**            **SUBMITTALS**

- .1      Submit under provisions of Division 01.
- .2      Specification Conformance Document: Indicate whether the submitted equipment:
  - .1      Meets specification exactly as stated.
  - .2      Meets specification via an alternate means and indicate the specific methodology used.
- .3      Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

**1.5**            **QUALITY ASSURANCE**

- .1      Manufacturer's Quality System: Registered to ISO 9001 Quality Standard, including in-house engineering for product design activities.
- .2      Recognized by UL. Provide evidence of compliance upon request.

**1.6**            **PROJECT CONDITIONS**

- .1      Do not install equipment until following conditions can be maintained in spaces to receive equipment:

- .1 Ambient temperature: 0 degrees to 40 degrees C.
- .2 Relative humidity: Maximum 90 percent, non-condensing.
- .3 Protected from dust and excess moisture during installation.

## **1.7 WARRANTY**

- .1 Provide manufacturer's warranty covering 5 years with factory startup on drivers from date of purchase.

## **1.8 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Make replacements available for minimum of 10 years from date of manufacture.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Ten-year operational life while operating with a case temperature range of 0 degrees C to 62 degrees C and 90 percent non-condensing relative humidity.
- .2 Designed and tested to withstand electrostatic discharges up to 15,000 V without impairment per IEC 801-2.
- .3 Electrolytic capacitors are sensitive to heat in a dimming circuit. Their expected lifetime doubles for every 10 degrees C that the component operates below the capacitor's rated operating temperature.
- .4 Electrolytic capacitors to operate at least 20 degrees C below the capacitor's maximum temperature rating when the driver is under fully-loaded conditions and case temperature is 62 degrees C.
- .5 Maximum inrush current of 2 amperes for 120V.
- .6 Inaudible in a 27 dBA ambient.
- .7 No visible change in light output with a variation of +/- 10 percent line voltage input.
- .8 Total Harmonic Distortion less than 20 percent and meet ANSI C82.11 maximum allowable THD requirements
- .9 Drivers to track evenly across
  - .1 Multiple fixtures.
  - .2 All light levels.
- .10 Stand by power is <1.0Watts when using digital controls.
- .11 Compatibility of driver and LED light engine must be tested and ensured by driver manufacturer.

**2.2 DIGITAL CONTROL**

- .1 Ability to operate with installed or specified building control system.

**2.3 SOURCE QUALITY CONTROL**

- .1 Perform full-function testing on 100 percent of all drivers at the factory.
- .2 Perform built-in at 40 degrees C ambient temperature on 100 percent of all drivers at the factory.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install equipment in accordance with manufacturer's installation instructions.
- .2 Provide complete installation of system in accordance with Contract Documents.
- .3 Lead lengths to LED light engine/array not to exceed 0.9m.

**3.2 SERVICE AND SUPPORT**

- .1 Tech Support
  - .1 Provide factory direct technical support hotline 24 hours per day, 7 days per week.

**3.3 MAINTENANCE**

- .1 Provide on-site service support within 72 hours.
- .2 Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of commissioning.

**END OF SECTION**



**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      Section includes:
  - .1      Stand-a-lone occupancy and Vacancy Sensor Control.

**1.2**            **REFERENCES**

- .1      Canadian Standards Association (CSA).
  - .1      CSA C22.2 # 14 Industrial Control Equipment
  - .2      CSA C22.2 # 184 Solid-State Lighting Controls
- .2      International Electrotechnical Commission.
  - .1      (IEC) 801-2 Electrostatic Discharge Testing Standard.
  - .2      IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.
- .3      Underwriters Laboratories, Inc. (UL):
  - .1      508 (2005) - Standard for Industrial Control Equipment.
  - .2      244A – Appliance Controls

**1.3**            **SYSTEM DESCRIPTION**

- .1      Permanently installed stand-a-lone
  - .1      Wall mounted occupancy sensors
  - .2      Ceiling mounted occupancy sensors

**1.4**            **SUBMITTALS**

- .1      Submit under provisions of Division 01.
- .2      Specification Conformance Document: Indicate whether the submitted equipment:
  - .1      Meets specification exactly as stated.
  - .2      Meets specification via an alternate means and indicate the specific methodology used.
- .3      Shop Drawings; include:
  - .1      Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
  - .2      Schematic of system.
  - .3      Lighting plan clearly marking product type, location and orientation of each sensor.

- .4 Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

## **1.5 QUALITY ASSURANCE**

- .1 Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.

## **1.6 PROJECT CONDITIONS**

- .1 Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  - .1 Ambient temperature: 0 degrees to 40 degrees C.
  - .2 Relative humidity: Maximum 90 percent, non-condensing.
  - .3 Protect from dust during installation.

## **1.7 WARRANTY**

- .1 Provide manufacturer's standard parts warranty.

## **1.8 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Make ordering of new equipment for expansions, replacements, and spare parts available to end user.
- .2 Make new replacement parts available for minimum of ten years from date of manufacture.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Provide system that is designed, tested, manufactured, and warranted by a single manufacturer.
- .2 Architectural Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C to 40 degrees C and 90 percent non-condensing relative humidity.

### **2.2 SENSOR PERFORMANCE REQUIREMENTS**

- .1 Sensing mechanism:
  - .1 Dual technology:
- .2 Field adjustable controls for time delay and sensitivity to override any adaptive features.
- .3 Power failure memory:

- .1 Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and learned parameters saved in protected memory shall not be lost.

### **2.3 CEILING MOUNT SENSORS**

- .1 Provide all necessary mounting hardware and instructions.
- .2 Sensors shall be Class 2 devices.
- .3 Indicate viewing directions on mounting bracket for all Ceiling mount sensors.
- .4 Provide customizable mask to block off unwanted viewing areas for all ceiling mounted sensors using infrared technology.
- .5 120/347 V, 60 Hz, line voltage
- .6 Ultrasonic frequency: 40 Khz
- .7 Time delays: Auto set fixed (5, 10, 15, to or 30 minutes), work-through test mode.
- .8 Sensitivity adjustment: Auto set or reduced sensitivity.
- .9 Built-in light level sensor -10 to 300 foot candles.
- .10 360° Fresnel lens.
- .11 Provide swivel mount base for all wall mount sensors.
- .12 Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

### **2.4 WALL MOUNT SENSORS**

- .1 120VAC or 347VAC as indicated, line voltage.
- .2 0-1500W ballast.
- .3 Time delays: 5, 15, or 30 minutes, walk through, test mode.
- .4 Coverage:
  - .1 Major Motion: PIR 35' x 30' ultrasonic 20' x 20'
  - .2 Minor Motion: PIR 20' x15' ultrasonic 15' x 15'
- .5 Sensitivity Adjustment: PIR (high/low), ultrasonic (fully variable)

### **2.5 SOURCE QUALITY CONTROL**

- .1 Perform full-function testing on 100 percent of all system components and panel assemblies at the factory.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1      Install equipment in accordance with manufacturer's installation instructions.
- .2      Provide complete installation of system in accordance with Contract Documents.
- .3      Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

**3.2**            **SERVICE AND SUPPORT**

- .1      Startup and Programming
  - .1      Provide factory-certified field service engineer to a site visit to ensure proper system installation and operation under following parameters:
    - .1      Qualifications for factory-certified field service engineer:
      - .1      Certified by the equipment manufacturer on the system installed.
      - .2      Make a visit upon completion of installation of lighting control system:
        - .1      Verify connection and location of controls.
        - .2      Verify system operation control by control, zone by zone.
        - .3      Obtain sign-off on system functions.
  - .2      Tech Support
    - .1      Provide factory direct technical support hotline 24 hours per day, 7 days per week.

**3.3**            **MAINTENANCE**

- .1      Capable of providing on-site service support within 24 hours.
- .2      Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SCOPE**

- .1 The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm.
- .2 The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in CSA Z462 – Workplace Electrical Safety. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in CSA Z462, Annex D.
- .3 The scope of the studies shall include all new distribution equipment supplied by the equipment manufacturer under this contract.

**1.2 REFERENCES**

- .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
  - .2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
  - .3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
  - .4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
  - .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
  - .6 IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.
- .2 American National Standards Institute (ANSI):
  - .1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
  - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
  - .3 ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
  - .4 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- .3 The National Fire Protection Association (NFPA)
  - .1 NFPA 70 - National Electrical Code, latest edition.
  - .2 NFPA 70E – Standard for Electrical Safety in the Workplace.
- .4 Canadian Standards Association (CSA)

- .1 CSA Z462 – Workplace Electrical Safety.

### **1.3 SUBMITTALS FOR REVIEW/APPROVAL**

- .1 The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing and/or project schedule, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

### **1.4 SUBMITTALS FOR CONSTRUCTION**

- .1 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.
- .2 The report shall include the following sections:
  - .1 One-line diagram showing protective device ampere ratings and associated designations, cable size and lengths, transformer kVA and voltage ratings, motor and generator kVA ratings, and switchgear/switchboard/panelboard designations.
  - .2 Descriptions, purpose, basis and scope of the study.
  - .3 Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.
  - .4 Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.
  - .5 Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout.
  - .6 Incident energy and flash protection boundary calculations.
  - .7 Comments and recommendations for system improvements, where needed.
  - .8 Executive Summary including source of information and assumptions made.

### **1.5 QUALIFICATIONS**

- .1 The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- .2 The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.

- .3 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed.

## **PART 2 PRODUCTS**

### **2.1 STUDIES**

- .1 Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker in the 208 Volt panelboards. Study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency standby generator and distribution switchgear.
- .2 The contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462 - Workplace Electrical Safety, reference Article 4.3.3 and Annex D.

### **2.2 DATA COLLECTION**

- .1 Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- .2 Source combination may include present and future utility supplies, motors, and generators.
- .3 Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Departmental Representative or Contractor.
- .4 If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

### **2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY**

- .1 Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141, latest edition.
- .2 Transformer design impedances and standard X/R ratios shall be used when test impedances are not available.
- .3 Provide the following:
  - .1 Calculation methods and assumptions.

- .2 Selected base per unit quantities.
- .3 One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted.
- .4 Source impedance data, including electric utility system and motor fault contribution characteristics.
- .5 Tabulations of calculated quantities.
- .6 Results, conclusions, and recommendations.
- .4 Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
  - .1 Electric utility's supply termination point.
  - .2 Incoming switchgear.
  - .3 Unit substation primary and secondary terminals.
  - .4 Low voltage switchgear.
  - .5 Standby generators and automatic transfer switches.
  - .6 Branch circuit panelboards.
  - .7 Other significant locations throughout the system.
- .5 For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- .6 Protective Device Evaluation:
  - .1 Evaluate equipment and protective devices and compare to short circuit ratings.
  - .2 Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses.
  - .3 Adequacy of transformer windings to withstand short-circuit stresses.
  - .4 Cable and busway sizes for ability to withstand short-circuit heating.

## 2.4

### PROTECTIVE DEVICE COORDINATION STUDY

- .1 Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- .2 Include on each curve sheet, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- .3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- .4 Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- .5 Plot the following characteristics on the curve sheets, where applicable:
  - .1 Electric utility's overcurrent protective device.
  - .2 Medium voltage equipment overcurrent relays.
  - .3 Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.



- .4 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
- .5 Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
- .6 Conductor damage curves.
- .7 Ground fault protective devices, as applicable.
- .8 Pertinent motor starting characteristics and motor damage points, where applicable.
- .9 Pertinent generator short-circuit decrement curve and generator damage point.
- .6 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

## **2.5 ARC FLASH HAZARD ANALYSIS**

- .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in CSA Z462, Annex D.
- .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards, busway and splitters) where work could be performed on energized parts.
- .3 The Arc-Flash Hazard Analysis shall include all MV, 600V locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.
- .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of  $1.2 \text{ cal/cm}^2$ .
- .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.
- .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

- .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
- .2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- .8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- .9 Where performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- .10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- .11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

## 2.6 REPORT SECTIONS

- .1 Input data shall include but not be limited to the following:
  - .1 Utility 3-phase and L-G available contribution with associated X/R ratios.
  - .2 Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
  - .3 Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
  - .4 Reactor data, including voltage rating, and impedance.
  - .5 Generation contribution data, (synchronous generators and Utility), including short-circuit reactance ( $X''_d$ ), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
  - .6 Motor contribution data (induction motors and synchronous motors), including shortcircuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
- .2 Short-Circuit Output Data shall include, but not be limited to the following reports:
  - .1 Low voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each application location:
    - .1 Voltage

- .2 Calculated fault current magnitude and angle
- .3 Fault point X/R ratio
- .4 Equivalent impedance
- .2 Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
  - .1 Voltage
  - .2 Calculated symmetrical fault current magnitude and angle
  - .3 Fault point X/R ratio
  - .4 Calculated asymmetrical fault currents
    - .1 Based on fault point X/R ratio
    - .2 Based on calculated symmetrical value multiplied by 1.6
    - .3 Based on calculated symmetrical value multiplied by 2.7
  - .5 Equivalent impedance.
- .3 Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
  - .1 Voltage.
  - .2 Calculated symmetrical fault current magnitude and angle.
  - .3 Fault point X/R ratio.
  - .4 No AC Decrement (NACD) Ratio.
  - .5 Equivalent impedance.
  - .6 Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
  - .7 Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.
- .3 Recommended Protective Device Settings:
  - .1 Phase and Ground Relays:
    - .1 Current transformer ratio.
    - .2 Current setting.
    - .4 Time setting.
    - .5 Instantaneous setting.
    - .6 Recommendations on improved relaying systems, if applicable.
  - .2 Circuit Breakers:
    - .1 Adjustable pickups and time delays (long time, short time, ground)
    - .2 Adjustable time-current characteristic.
    - .3 Adjustable instantaneous pickup.
    - .4 Recommendations on improved trip systems, if applicable.
- .4 Incident energy and flash protection boundary calculations:
  - .1 Arcing fault magnitude.
  - .2 Protective device clearing time.

- .3 Duration of arc.
- .4 Arc flash boundary.
- .5 Working distance.
- .6 Incident energy.
- .7 Hazard Risk Category.
- .8 Recommendations for arc flash energy reduction.

### **PART 3**      **EXECUTION**

#### **3.1**      **FIELD ADJUSTMENT**

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- .3 Notify Engineer in writing of any required major equipment modifications.

#### **3.2**      **ARC FLASH WARNING LABELS**

- .1 The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Departmental Representative and after any system changes, upgrades or modifications have been incorporated in the system.
- .3 The label shall have an orange header with the working: "WARNING: ARC FLASH HAZARD" and shall include the following information, at a minimum:
  - .1 Location designation
  - .2 Nominal voltage
  - .3 Flash protection boundary
  - .4 Hazard risk category
  - .5 Incident energy
  - .6 Working distance
  - .7 Engineering report number, revision number and issue date.
- .4 Labels shall be machine printed, with no field markings.
- .5 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
  - .1 For each 600 and 208 volt panelboard, one arc flash label shall be provided.
  - .2 For each motor control center, one arc flash label shall be provided.
  - .3 For each low voltage switchboard, one arc flash label shall be provided.
  - .4 For each switchgear, one arc flash label shall be provided.

.5 For medium voltage switches one arc flash label shall be provided.

### **3.3 ARC FLASH TRAINING**

- .1 The contractor of the Arc Flash Hazard Analysis shall train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours).

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SCOPE**

- .1      The Contractor shall furnish and install where indicated on the drawings a dead front type, low-voltage service entrance panel combining a main breaker, utility metering transformer compartment and distribution feeder section in a single enclosure. The panel must be completely factory assembled and CSA listed. The design shall allow for the assembly to be reversed in the field without modification, to accommodate either top or bottom entry of service cables.

**1.2**            **RELATED SECTIONS**

- .1      Section 01 33 00 – Submittal Procedures
- .2      Section 01 78 00 – Closeout Submittals
- .3      Section 26 05 00 – Common Work Results-Electrical.
- .4      Section 26 24 05 – Service Entrance TVSS Protection
- .5      Section 26 28 16.02 – Moulded Case Circuit Breakers

**1.3**            **REFERENCES**

- .1      The low voltage switchboard assembly and all components shall be designed, manufactured, and tested in accordance with the latest applicable following standards:
  - .1      CSA C22.2 No.31
  - .2      CSA C22.2 No.5

**1.4**            **SUBMITTALS – FOR REVIEW/APPROVAL**

- .1      The following information shall be submitted to the Departmental Representative.
  - .1      Front view and plan view of the assembly.
  - .2      Single line or three line diagram.
  - .3      Schematic diagram (where required).
  - .4      Component list.
  - .5      Floor plan with conduit/cable space locations.
  - .6      Assembly ratings including:
    - .1      Short circuit rating.
    - .2      Voltage class.
    - .3      Continuous current rating.
  - .7      Major component ratings including:
    - .1      Voltage class.

- .2 Continuous current.
- .3 Interrupting ratings.
- .8 Cable lug/termination sizes.
- .2 Submit the above information in accordance with Section 01 33 00 – Submittal Procedures.

## **1.5 SUBMITTALS – FOR INFORMATION**

- .1 When requested by the Engineer the following product information shall be submitted.
  - .1 Descriptive bulletins.
  - .2 Product sheets.

## **1.6 SUBMITTALS – FOR CLOSE-OUT**

- .1 The following information shall be submitted for record purposes prior to final payment.
  - .1 Final as-built drawings for items listed in Section 1.04.
  - .2 Wiring diagrams (where applicable).
  - .3 Installation information including equipment anchorage provisions.
- .2 Submit the above information integral with the Operation and Maintenance Manuals specified under Section 01 78 00 – Closeout Submittals.
- .3 The final as-built drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

## **1.7 QUALIFICATIONS**

- .1 The manufacturer of the assembly shall be the manufacturer of the breakers installed within the assembly.
- .2 When requested by the Departmental Representative, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this request.

## **1.8 REGULATORY REQUIREMENTS**

- .1 The switchboard shall comply with the latest standard CSA C22.2 No.31. The assembly shall bear a CSA label. All moulded case circuit breakers and components contained in this switchboard shall bear a CSA label and comply with the latest issue of standard CSA C22.2 No.5.

**1.9 DELIVERY, STORAGE AND HANDLING**

- .1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

**PART 2 PRODUCTS**

**2.1 RATINGS**

- .1 Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum service.
- .2 The service panel bus shall be rated as indicated on the drawings.
- .3 The assembly shall be rated, type tested and CSA listed. Short circuit withstand as noted on the drawings.
- .4 All bussing shall be silver flashed copper and braced as per short circuit requirements of 2.2.3 above.

**2.2 CONSTRUCTION**

- .1 The service entrance switchboard shall be CSA Type 1 sprinkler proof enclosed and fabricated from code gauge formed galvanized steel complete with flat sheet covers to form a rigid dead front, totally enclosed structure. The service entrance switchboard shall be floor mounted, wall supported.
- .2 All compartments are to be designed to make components totally front accessible to enable the panel to be installed against the wall.
- .3 Isolation barriers shall be provided to separate the main disconnect device, the utility current/potential transformer section and the distribution section into three separate compartments. Ventilation shall be provided to meet CSA C22.2 No.31 temperature rise requirements. Ventilation shall not jeopardize sprinkler proof rule 26-008 of the Canadian Electrical Code.
- .4 All structures and covers are to be painted ASA-61 Grey.
- .5 Silver flashed copper bus from main section to distribution sections including vertical bussing.
- .6 Lamacoid nameplates shall be supplied in accordance with the nameplate schedule supplied by the Contractor or Engineer. Nameplates shall be secured with screws.

**2.3 MAIN BREAKER**

- .1 The main breaker shall be rated for 100% current capacity and complete with electronic trip unit with fully adjustable LSI protection pickup and LS protection time delay for



selective protection. The breaker's interrupting rating shall be as noted on the drawings, RMS Symmetrical at 600V. The breaker shall be fixed mount.

- .2 The main breaker section shall be complete with provisions for padlocking the main breaker and sealing screws on the front cover. A removable disconnect link to ground the neutral, the service conduit, and the system ground must be supplied.

## **2.4 UTILITY METERING TRANSFORMER COMPARTMENT**

- .1 The utility transformer compartment shall be designed to meet the local utility requirements. It shall be bussed and pre-drilled to accept standard bar type and/or window type current transformers. The compartment shall have a bolt-on cover and access door with concealed hinges, both sealable to protect from tampering.

## **2.5 DISTRIBUTION SECTION**

- .1 The distribution section shall be designed to accept the installation of circuit breakers. A flat cover shall be supplied and any space not occupied by a feeder breaker shall have a filler plate allowing no access to parts when energized.
- .2 The distribution panel shall accommodate a minimum of 14 - 3 pole breakers. The panel section shall have provisions to accept breakers to a maximum of 800A. Feeder breakers, of 150A, 225A and 250A frame size (3 Pole) shall take no more than 3X space. 400A Frame size (3 Pole) shall take no more than 4X space.
- .3 Feeder breakers shall be supplied as shown on the one-line drawings. Interrupting capacity of feeder breakers shall be as noted on the drawings, RMS Symmetrical at 600 VAC.
- .4 Feeder breakers indicated to be complete with LSI and LSIG protection shall be moulded case type complete with electronic trip unit with fully adjustable LSI or LSIG protection pickup and LS or LSG protection time delay for selective protection.

## **2.6 OPTIONAL FEATURES**

- .1 Include the following:
  - .1 Dripshield for sprinkler proof requirements.
  - .2 Ground Bus in the panel section.
  - .3 200% rated neutral bus.
  - .4 Door over distribution panel.
  - .6 Transient voltage surge suppressor (refer to 26 24 05).

## **PART 3 EXECUTION**

### **3.1 FACTORY TESTING**

- .1 The switchboard shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchboard shall be tested to ensure the accuracy of the wiring and the functioning of all equipment. The main bus system shall

be given a dielectric test of 2200 volts for one minute between live parts and ground and between opposite polarities.

- .2 The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute, or 1800 volts for one second, between live parts and ground, in accordance with ANSI C37.20.1.
- .3 A certified test report of all standard production tests shall be shipped with each assembly.

### **3.2 FIELD QUALITY CONTROL**

- .1 Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of two (2) working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- .2 The Contractor shall provide copies of the manufacturer's field start-up report in the Operation and Maintenance Manuals.

### **3.3 MANUFACTURER'S CERTIFICATION**

- .1 A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- .2 The Contractor shall provide copies of the manufacturer's representative's certification in the Operation and Maintenance Manuals before final payment.

### **3.4 INSTALLATION**

- .1 The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- .2 All necessary hardware to secure the assembly in place shall be provided by the Contractor.
- .3 The Equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:
  - .1 Checking to ensure that the pad location is level to within 0.125 inches per three foot of distance in any direction.
  - .2 Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
  - .3 Securing assemblies to foundation and to the wall.
  - .4 Measuring and recording Megger readings phase-to-phase, phase-to-ground, and neutral-to-ground (four wire systems only).

- .5 Inspecting and installing all circuit breakers in their proper compartments.
- .4 Coordinate, supply and installation of utility current transformers and potential transformers for utility metering with Utility Representative.
- .5 Install main building ground system and connect to neutral bus.
- .6 Check trip settings to ensure proper operation, protection and coordination of components.
- .7 Check operation of TVSS.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **REFERENCES**

- .1 Codes and standards referenced in this section refer to the latest edition thereof.
- .2 ANSI/IEEE C67.41, C62.45.
- .3 UL1449 - Second edition.
- .4 NFPA.
- .5 IEEE Standard 1100.
- .6 UL1283 - EMI/RRI noise attenuation standard.
- .7 NEMA LS1.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 26 05 00 – Common Work Results – Electrical.
- .3 Section 26 24 02 – Service Entrance Switchboard.

**1.3**            **SUBMITTALS**

- .1 Submittal for approval: Provide the following transient protection submittals:
  - .1 Dimensional drawing of each transient voltage surge suppressor (TVSS) type, indicating proposed mounting arrangements.
  - .2 Written functional description of the transient protection circuit in terms of components, configuration, design approach, and performance capability per NEMA LS1.
  - .3 The means of connection of the TVSS to the electrical distribution system per NEMA LS1.
- .2 Provide UL-1449, Second Edition data card from manufacturer showing the Suppressed Voltage Rating (SVR) for the specific catalog number submitted. Typical UL 1449, Second Edition data is not acceptable.
- .3 Per the requirements of NEC Article 285.6, mark the devices with the short circuit current rating. Meet or exceed the available fault current. Provide test data from an independent testing laboratory to demonstrate the short circuit current rating has been tested on a complete device
- .4 Submit test report data clearly demonstrating the maximum surge current rating has been tested on a COMPLETE TVSS unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems.

- .5 Submit data demonstrating the TVSS unit, including all overcurrent protection, is fully capable of a minimum repetitive surge current rating of 10,000 ANSI/IEEE C62.41, Category C3 (10kA) impulses without failure or a change in performance characteristics of more than 10%.

#### **1.4 WARRANTY**

- .1 Provide manufacturer's product warranty against defects in operation and material for a period of not less than 5 years from date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.1 ENVIRONMENTAL**

- .1 General Requirements:
  - .1 No audible noise.
  - .2 No appreciable magnetic fields. Provide proven application of use directly in computer rooms in any location without danger to disc units, disk packs, or tapes.
  - .3 Operating Conditions:
    - .1 30 to 130 Degrees F
    - .2 15 to 85 Percent Humidity Non-Condensing
  - .4 Enclosure: Heavy duty NEMA 2, drip-tight enclosure, as indicated.

#### **2.2 TRANSIENT VOLTAGE SURGE SUPPRESSORS**

- .1 General Requirements:
  - .1 Rated for a 347/600 volt, 60 Hertz, 3-phase, 4-wire switchboard, amperage as indicated.
- .2 Provide surge suppressors in accordance with the following requirements:
  - .1 Unit parallel in design and connected in parallel to main switchboard. Each surge suppression element (MOV) individually fused so that a failure of one element and/or fuse has no affect other surge suppression elements.
  - .2 Provide UL 1449, 2<sup>nd</sup> edition listed unit.
  - .3 Provide maximum UL 1449 2<sup>nd</sup> Edition Suppressed Voltage Rating (SVR) for 347/600 Volt systems as follows:
    - .1 L-N = 700V
    - .2 L-G = 700V
    - .3 N-G = 700V
    - .4 L-L = 1500V
  - .4 Provide maximum surge current rating of 100,000 amperes L-N, 100,000 amperes L-G, and 100,000 amperes N-G, based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform. Provide a higher maximum surge current rated device if required to meet the requirements of paragraph 1.03, B., 7. above.
  - .5 Provide unit with a short circuit current rating, which equals or exceeds that of the Main Switchboard.

- .6 Provide UL 1283 listed unit as an electromagnetic interference filter and provide 50 Ohm noise attenuation of at least 30 dB at 100 kHz, 50 dB at 1 MHz, 50 dB at 10 MHz, and 45 dB at 100 MHz.
- .7 Include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.
- .8 Provide Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of TVSS status.
- .9 Provide integral, non-fused disconnect system which causes no interruption to the protected load for testing and maintenance. Disconnect system shall not require removal or replacement for warranty or other repairs.
- .10 Provide an audible alarm with an alarm on/off switch to silence the alarm and a push-to-test switch to test the alarm function.
- .11 Provide an adjustable (resetable) counter to totalize transient voltage surges in both the normal and common mode. Provide readout with at least a seven-digit LCD located on the unit front cover and provided with a 10-year battery back-up to maintain counts in the event of power loss.
- .12 ISO 9001 certified.

### **PART 3**      **EXECUTION**

#### **3.1**      **GENERAL REQUIREMENTS**

- .1 Install suppression system immediately next to service equipment where so approved by the Departmental Representative.
- .2 Install conductors between suppressor and point of attachment to service equipment sized in accordance with manufacturer's Shop Drawings and conductor lengths as short as possible, preferably not to exceed 600 mm.
- .3 Grounding: bond suppressor ground to the equipment grounding conductor and service entrance ground.

#### **3.2**      **FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical and in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Inspect primary and secondary connections for tightness and signs of overheating.
- .3 Check fuses for correctness of type and size.
- .4 Check grounding connections.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **SECTION INCLUDES**

- .1      Materials and installation for standard and custom breaker type panelboards.

**1.2**      **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 26 05 00 - Common Work Results - Electrical.
- .3      Section 26 28 16.02 - Moulded Case Circuit Breakers.

**1.3**      **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CSA C22.2 No.29, Panelboards and enclosed Panelboards.

**1.4**      **SUBMITTALS**

- .1      Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**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 and breakers rated for 10,000 and 18,000 A (symmetrical) minimum interrupting capacity respectively or as indicated on electrical drawings.
- .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      Sprinkler proof construction.
- .6      Two keys for each panelboard and key panelboards alike.

- .7 Tin plated copper bus with neutral of same ampere rating as mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked grey enamel.
- .11 Lockable front hinged covers.
- .12 Lighting and Branch Circuit Panelboards: Cutler Hammer POW-R-Line 1a/2a or equivalent.
- .13 Power Distribution Panelboards: Cutler Hammer POW-R-Line 4 or equivalent. Breakers indicated as LSIG trip to be complete with Digi Trip Optim 1050 electronic relay or equivalent.

## **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 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .5 Lock-on devices for receptacles, fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits as indicated.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - 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.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.



- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 – Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **SECTION INCLUDES**

- .1      Switches, receptacles, wiring devices, cover plates and their installation.

**1.2**      **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 26 05 00 - Common Work Results - Electrical.

**1.3**      **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2      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, twelfth edition).

**PART 2**      **PRODUCTS**

**2.1**      **SWITCHES**

- .1      15 A, 120 V, or 347 V single pole, double pole, three-way, 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      White toggle, Ivory for Three Position switch.
  - .6      Heavy Duty Industrial Grade.
  - .7      Maintained Contact, Three Position, Two Circuit, Centre Off, SPDT where shown on drawings.
- .3      Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4      Switches of one manufacturer throughout project.

## 2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground and CSA types 20R, 125V, 20A, U ground, to: CSA-C22.2 No.42 with following features:
  - .1 White thermoplastic 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.
  - .6 Heavy Duty Specification Grade.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.

## 2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel cover plates as indicated, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .6 Weatherproof "While-in-use" polycarbonate self-closing cover plates complete with gaskets for duplex receptacles as indicated.
- .7 Weatherproof "While-in-use" polycarbonate self-closing cover plates complete with gaskets for single receptacles or switches as indicated.

## 2.4 WALLBOX DIMMERS

- .1 Provide dimmer switches and wall plate kits that are designed, tested, manufactured, warranted, and provided by a single manufacturer unless otherwise noted.
- .2 Dimmers:
  - .1 Dimmers provide full range, continuously variable control of light intensity.
  - .2 Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0° C to 40° C.
  - .3 Operate at the rated capacity across the full ambient temperature range including modified capacities for ganging configurations which require the removal of fins.
  - .4 Provide Radio Frequency Interference Suppression on dimming controls.

- .5 Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply eliminating any leakage current.
- .6 Possess power failure memory such that if power is interrupted and subsequently returned, lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption for a minimum period of 2 years.
- .3 Product to be compatible with 0-10V dimming driver supplied.
- .4 Wall Plates
  - .1 Provide an adapter plate for proper device alignment and wall plate attachment.
  - .2 Architectural style face plates.

### **PART 3**      **EXECUTION**

#### **3.1**      **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 - Electrical.
- .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 - Electrical.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover plates:
  - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**END OF SECTION**

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**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 78 00 – Closeout Submittals.
- .2      Section 26 05 00 – Common Work Results - Electrical.

**1.2**            **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CSA C22.2No.248.12, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).

**1.3**            **SUBMITTALS**

- .1      Submit fuse performance data characteristics for each fuse type and size above 600 A. Performance data to include: average melting time-current characteristics.

**1.4**            **DELIVERY AND STORAGE**

- .1      Ship fuses in original containers.
- .2      Do not ship fuses installed in switchboard.
- .3      Store fuses in original containers in storage cabinet moisture free location.

**1.5**            **MAINTENANCE 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 600 A.
- .3      Six spare fuses of each type and size installed up to and including 600 A.

**PART 2**      **PRODUCTS**

**2.1**            **FUSES GENERAL**

- .1      Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2      Fuses: product of one manufacturer for entire project.

**2.2**            **FUSE TYPES**

- .1      Class L fuses (formerly HRC-L).

- .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2 Type L2, fast acting.
- .2 Class J fuses (formerly HRCI- J).
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.
- .3 Class R -R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and its' peak let-through values not to exceed limits of UL 198E-1982, table 10.2.
  - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
  - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4 Class -C fuses (formerly HRCII- C).

### **2.3 FUSE STORAGE CABINET**

- .1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 – Common Work Results - Electrical.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install fuses in mounting devices immediately before energizing circuit. Ensure correct fuses fitted to physically matched mounting devices.
  - .1 Install Class R rejection clips for HRCI-R fuses.
- .2 Ensure correct fuses fitted to assigned electrical circuit.
- .3 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 26 05 00 - Common Work Results – Electrical.

**1.2**      **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 with ampacity of 600 A and over.
  - .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: Government of Canada Building - Bay d'Espoir, NL.
          - .2      End user's reference number: Project # 1005744.

.3 List of circuit breakers included.

**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 indoors 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.
- .4 Packaging Waste Management: remove and return for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**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 with temperature compensation for 40°C ambient.
- .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. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Circuit breakers to have symmetrical rms interrupting capacity rating, as indicated, minimum of 10,000 A.

**2.2 THERMAL MAGNETIC BREAKERS DESIGN A**

- .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.

**2.3 SOLID STATE TRIP BREAKERS DESIGN D**

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under



overload condition, and long time, short time and instantaneous tripping for phase protection (LSI), with ground fault short circuit protection (LSIG) as indicated.

## **2.4 OPTIONAL FEATURES**

- .1 Include as indicated:
  - .1 Shunt trip.
  - .2 Auxiliary switch.
  - .3 On-off locking device.

## **2.5 ENCLOSURE**

- .1 Mounted in NEMA 1 type enclosure, sprinkler proof as indicated.

## **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 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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 26 05 00 – Common Work Results - Electrical.

**PART 2**      **PRODUCTS**

**2.1**      **DISCONNECT SWITCHES**

- .1      Fusible and non-fusible, NEMA rated disconnect switch in CSA Enclosure type 1, size as indicated.
- .2      Provision for padlocking in on-off switch position by three locks.
- .3      Mechanically interlocked door to prevent opening when handle in ON position.
- .4      Fuses: size as indicated, to Section 26 28 13.01 - Fuses - Low Voltage.
- .5      Fuseholders: 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      Exterior disconnect switches shall be complete with NEMA 4X, corrosion resistant enclosure.
- .9      All disconnects shall be heavy duty version.
- .10     All interior disconnects shall be rated sprinkler-proof.

**2.2**      **EQUIPMENT IDENTIFICATION**

- .1      Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2      Indicate name of load controlled on size 4 nameplate.

**PART 3**      **EXECUTION**

**3.1**      **INSTALLATION**

- .1      Install disconnect switches complete with fuses as indicated.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SECTION INCLUDES**

- .1        Materials and installation for contactors for system voltages up to 600 V

**1.2**            **RELATED SECTIONS**

- .1        Section 01 33 00 - Submittal Procedures.
- .2        Section 26 05 00 - Common Work Results - Electrical.
- .3        Section 26 29 03 - Control Devices.

**1.3**            **REFERENCES**

- .1        Codes and standards referenced in this section refer to the latest edition thereof.
- .2        Canadian Standards Association (CSA)
  - .1        CSA C22.2 No.14, Industrial Control Equipment.

**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        Fused switch combination contactor as indicated.
- .4        Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .5        Mount in CSA Enclosure 1 unless otherwise indicated.
- .6        Include following options in cover:
  - .1        Red indicating LED.
  - .2        Hand-Off-Auto selector switch.
- .7        Control transformer: in accordance with Section 26 29 03 - Control Devices, in contactor enclosure.

**2.2**            **EQUIPMENT IDENTIFICATION**

- .1        Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

- .2 Size 4 nameplate indicating name of load controlled as indicated.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1 Install contactors and connect auxiliary control devices.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **SECTION INCLUDES**

- .1      Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

**1.2**      **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 26 05 00 - Common Work Results - Electrical.

**1.3**      **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CSA C22.2 No.14, Industrial Control Equipment.
- .3      National Electrical Manufacturers Association (NEMA)
  - .1      NEMA ICS 1, Industrial Control and Systems: General Requirements.

**1.4**      **SUBMITTALS**

- .1      Include schematic, wiring, interconnection diagrams.

**1.5**      **QUALITY ASSURANCE**

- .1      Submit to Departmental Representative one copy of test results.

**PART 2**      **PRODUCTS**

**2.1**      **CONTROL RELAYS**

- .1      Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2      Convertible contact type: contacts field convertible from NO to NC, electrically held, with solid state timer as indicated. Coil rating: as indicated. Contact rating: as indicated.
- .3      Sealed contact type: electrically held. Coil rating: as indicated. Contact rating: as indicated.
- .4      Universal pole type: electrically held convertible from NO to NC by changing wiring connections. Coil rating: as indicated. Contact rating: as indicated.
- .5      Fixed contact plug-in type: general purpose low coil current. Coil rating: as indicated. Contact rating: as indicated.

- .6 Socket bases and DIN mounting rails for plug-in type relays.

## **2.2 RELAY ACCESSORIES**

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

## **2.3 OPERATOR CONTROL STATIONS**

- .1 Enclosure: CSA Type1, surface mounting:

## **2.4 PUSHBUTTONS**

- .1 Illuminated, Standard duty. Operator recessed mushroom type, as indicated, with 1-NO and 1-NC auxiliary contacts rated as indicated. Labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position and labelled "emergency stop".

## **2.5 SELECTOR SWITCHES**

- .1 Maintained 2 or 3 position labelled as indicated standard duty, operators wing lever, contact arrangement as indicated, rated as indicated.

## **2.6 INDICATING LIGHTS**

- .1 Standard duty, full voltage, transformer LED type, push-to-test, lens colour: as indicated, supply voltage as indicated, labels as indicated.

## **2.7 CONTROL AND RELAY PANELS**

- .1 CSA Type 1 sheet steel enclosure (sprinkler proof) with hinged padlockable access door, accommodating relays, timers, labels, as indicated, factory installed and wired to identified terminals.

## **2.8 CONTROL CIRCUIT TRANSFORMERS**

- .1 Single phase, dry type.
- .2 Primary: 208, 240 or 600 V, 60 Hz ac.
- .3 Secondary: 120 V, or 24V ac.
- .4 Rating: 50, 150, 250, 350 or 500 VA, as indicated.
- .5 Secondary fuse: size as required.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

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**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1      Install pushbutton stations, control and relay panels, control devices and interconnect as required on control wiring diagrams as per drawings.

**3.2**            **FIELD QUALITY CONTROL**

- .1      Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2      Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.
- .3      Upon completion of sectional test, undertake group testing.
- .4      Check out complete system for operational sequencing.

**END OF SECTION**

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**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 33 00 – Submittal Procedures.
- .2      Section 26 05 00 – Common Work Results - Electrical.

**1.2**            **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      International Electrotechnical Commission (IEC)
  - .1      IEC 947-4-1, Part 4: Contactors and motor-starters.

**1.3**            **SUBMITTALS**

- .1      Indicate:
  - .1      Mounting method and dimensions.
  - .2      Starter size and type.
  - .3      Layout of identified internal and front panel components.
  - .4      Enclosure types.
  - .5      Wiring diagram for each type of starter.
  - .6      Interconnection diagrams.

**1.4**            **CLOSEOUT SUBMITTALS**

- .1      Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2      Include operation and maintenance data for each type and style of starter.
- .3      Include complete programming information for solid state starters.

**1.5**            **EXTRA MATERIALS**

- .1      Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2      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 10% indicating lamp bulbs used.

## **PART 2      PRODUCTS**

### **2.1      MATERIALS**

- .1 Starters: to IEC 947-4 with AC4 utilization category.

### **2.2      MANUAL MOTOR STARTERS**

- .1 Single and Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

- .1 Switching mechanism, quick make and break.
- .2 One and Three overload heaters, manual reset, trip indicating handle.

- .2 Accessories:

- .1 Toggle switch or pushbutton: heavy duty labelled as indicated.
- .2 Indicating light: heavy duty type and colour as indicated.
- .3 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 to control disconnect, 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 Pushbuttons and 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      SOLID STATE STARTERS**

- .1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

- .1 Solid state starter.

- .2 Motor overload protective device in each phase, manually reset from outside enclosure.
- .3 Power and control terminals.
- .4 Wiring and schematic diagram inside starter enclosure in visible location.
- .5 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 to control disconnect and provision for:
  - .1 Locking in "OFF" position with up to three (3) padlocks.
  - .2 Locking in "ON" position.
  - .3 Independent locking of enclosure door.
  - .4 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Pushbuttons or 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.
- .4 Solid state (heavy duty version) starter complete with the following protection features:
  - .1 Ambient compensated be-metallic overloads.
  - .2 Phase loss.
  - .3 Phase sequence.
  - .4 DV/DT protection.
  - .5 Overtemperature.
  - .6 Shorted SCR indicator.
- .5 Solid state starter to meet the following specifications:
  - .1 Starter type: Open loop voltage control.
  - .2 Adjustments: Starting torque, 0-100%, ramp time; 0.5-60 sec., Acceleration kick; 50-100%.
  - .3 Voltage: 600 VAC 3 phase + 10%.
  - .4 Frequency: 60 Hz + 2 Hz.
  - .5 Power section: 6 SCR.
  - .6 SCR PIV: 1200 PIV thru 480 VAC, 1800 PIV at 575 VAC, 2600 PIV at 1000 VAC.
  - .7 Power rating: 20 time motor FLA 1 cycle, 500% motor current for 30 sec., 125% continuous.
  - .8 SCR voltage Drop: 1.0V nominal.
  - .9 Power Loss: 1.0 watt/amp/phase.
  - .10 Overall efficiency: 98.75%.
  - .11 SCR Firing: Digital block gate.
  - .12 Dielectric Test: 2500 VAV minimum.
  - .13 Transient Voltage Protection: R.C. snubbers.

- .14 Diagnostic L.E.D's: + 15 VDC Power ON, phase sequence/loss, starter ON, SCR gates, shorted SCR.
- .15 Synchronizing Transformer: Prim: 208 50/60 hz.
- .16 UV Protection: 80% pickup, 60% dropout.
- .17 Enclosure: OSA, others as specified.
- .18 Cooling: natural convection or fans.
- .19 Ambient Temperature: 0 to 40°C at sea level.
- .20 Power Connections: Incoming line and outgoing load lugs or terminals.
- .21 Control Input: Dry contact 2 or 3 aire for 24 VDC supplied.
- .22 Motor Protection: 3 pole Class 20 standard.
- .23 Auxiliary Contacts: One set form "C" (SPDT) 2 amps @ 125 2 amps @ 28 VDC, .6 amps @ 125 VAC UL.
- .24 Control Wiring: 600 VAC rated numbered per schematic.
- .25 Complete with soft stop, and pump control options.

## **2.5 CONTROL TRANSFORMER**

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 24 or 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.

## **2.6 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 – Common Work Results - Electrical.

## **2.7 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - 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, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.
- .3 Program solid-state starters. Coordinate with Departmental Representative and make all required changes.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical , manufacturer's instructions.
- .2 Operate switches, 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.
- .5 Test solid state starters and integrate with DDC System.

### **3.3 TRAINING**

- .1 Train Government of Canada staff in the operation of the solid state starters. Use a factory trained representative to complete the training. Allow sufficient time to permit staff to become totally familiar with all aspects of the operation.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
  - .1      American National Standards Institute (ANSI)
    - .1      ANSIC78.377, Specifications for Chromaticity of Solid State Lighting Products.
    - .2      ANSI C82.77, Harmonic Emission Limits – Related Power Quality Requirements for Lighting.
  - .2      American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
    - .1      ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.
  - .3      American Society for Testing and Materials (ASTM)
    - .1      ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
  - .4      United States of America, Federal Communications Commission (FCC)
    - .1      FCC (CFR47) EM and RF Interference Suppression.
  - .5      Consortium for Energy Efficiency (CEE) [www.cee1.org](http://www.cee1.org).
  - .6      Illuminating Engineering Society (IES)
    - .1      LM-79, Approved Method: Electrical and Photometric Testing of Solid State Lighting Devices.
    - .2      LM-80, Approved Method: Measuring Lumen Depreciation of LED Light Sources.
    - .3      TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.

**1.2**            **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 45 00 - Quality Control.

**1.3**            **SUBMITTALS**

- .1      Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.
- .2      Photometric data to include: VCP Table and spacing criterion.

**PART 2**      **PRODUCTS**

**2.1**            **FINISHES**

- .1      Baked enamel finish:

- .2 Conditioning of metal before painting:
  - .1 For corrosion resistance conversion coating to ASTM F1137.
  - .2 For paint base, conversion coating to ASTM F1137.
- .3 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel polyester powdercoat alzak aluminum to give smooth, uniform appearance, free from pinholes or defects.
- .4 Reflector and other inside surfaces finished as follows:
  - .1 White, minimum reflection factor 85%.
  - .2 Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fade-ometer not to exceed 0.05.
  - .3 Film thickness, not less than 0.03 mm average and in no areas less than 0.025 mm.
  - .4 Gloss not less than 80 units as measured with Gardner 60E gloss meter.
  - .5 Flexibility: withstand bending over 12 mm mandrel without showing signs of cracking or flaking under 10 times magnification.
  - .6 Adhesion: 24 mm square lattice made of 3 mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.
- .5 Alzak finish:
- .6 Aluminium sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:
  - .1 Finish for mild commercial service, minimum density of coating 7.8 g/m<sup>2</sup>, minimum reflectivity 83% for specular, 80.5% for semi-specular and 75% for diffuse.
  - .2 Finish for regular industrial service, minimum density of coating 14.8 g/m<sup>2</sup>, minimum reflectivity 82% for specular and 73% for diffuse.
  - .3 Finish for heavy duty service, minimum density of coating 21.8 g/m<sup>2</sup>, minimum reflectivity 85% for specular, 65% for diffuse.

## 2.2 DRIVERS

- .1 Dimming drivers must provide a current source that is compliant to IEC 60629 Annex E.2 and the inrush current must not exceed NEMA410 standards for electronic driver.

## 2.3 LUMINAIRES

- .1 LED luminaire type: A
  - .1 LED Rating: 14W, 3500K, 900 lumens output.
  - .2 Recessed 4" LED medium downlight.
  - .3 Mounting: indoor ceiling recessed.

- .4 Nominal dimensions: 144mm diameter x 144mm deep.
- .5 LED driver: Electronic, 120VAC, 0-10V dimming.
- .6 Spun aluminum lower reflector with a lensed upper optical chamber to provide minimum source brightness, self-flanged, semi-specular clear finish, medium beam. Retained with torsion springs to hold the flange tightly to the finished ceiling surface.
- .7 Extruded aluminum heat sink to conduct heat away from the LED module for optimal performance and long life.
- .8 LED system to contain a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens to produce an even distribution with no pixilation.
- .9 Auto resetting, thermally protected to turn off LED's when safe temperatures are exceeded.
- .10 Colour variation within 3-step MacAdam ellipses.
- .11 CRI:  $\geq 80$
- .2 LED luminaire type: B
  - .1 LED Rating: 28W, 3500K, 3400 lumens output.
  - .2 Lensed LED striplight.
  - .3 Mounting: indoor ceiling, chain hung.
  - .4 Nominal dimensions: 1219mm long x 77mm wide x 98mm deep.
  - .5 LED driver: Electronic, 120VAC, 0-10V dimming.
  - .6 Housing: die-formed cold rolled steel channel, complete with end plates and wireway cover.
  - .7 Lens: semi-frost for narrow distribution, complete with wire guard.
  - .8 CRI:  $\geq 80$
- .3 LED Luminaire type: C
  - .1 LED Rating: 20W, 3500K, 2026 lumens output.
  - .2 Recessed direct/indirect troffer LED luminaire.
  - .3 Mounting: Indoor T-Bar ceiling recessed.
  - .4 Nominal dimensions: 603 mm long x 603 mm wide x 152mm deep.
  - .5 LED Driver: Electronic, 120VAC, 0-10V dimming.
  - .6 Housing: Die-formed code gauge, prime cold rolled steel, heavy gauge end plates securely attached with screws for strength and rigidity and elimination of gaps.
  - .7 Finish: Durable cold rolled steel with multistage, iron phosphate pre-treatment and white enamel finish to ensure maximum bonding and rust inhibition.
  - .8 Reflectors: Indirect reflector with high reflectance baked matte white enamel finish for luminous uniformity, positively retained direct lamp shield constructed of heavy gauge perforated steel with high reflectance painted after fabrication finish and milky white overlay diffuser for visual comfort.
  - .9 CRI:  $\geq 80$
- .4 LED luminaire type: D

- .1 LED Rating: 29W, 3500K, 3071 lumens output.
  - .2 Recessed direct/indirect troffer LED luminaire.
  - .3 Mounting: Indoor T-Bar ceiling recessed.
  - .4 Nominal dimensions: 1211 mm long x 603 mm wide x 152mm deep.
  - .5 LED Driver: Electronic, 120VAC, 0-10V dimming.
  - .6 Housing: Die-formed code gauge, prime cold rolled steel, heavy gauge end plates securely attached with screws for strength and rigidity and elimination of gaps.
  - .7 Finish: Durable cold rolled steel with multistage, iron phosphate pre-treatment and white enamel finish to ensure maximum bonding and rust inhibition.
  - .8 Reflectors: Indirect reflector with high reflectance baked matte white enamel finish for luminous uniformity, positively retained direct lamp shield constructed of heavy gauge perforated steel with high reflectance painted after fabrication finish and milky white overlay diffuser for visual comfort.
  - .9 CRI:  $\geq 80$
- .5 LED luminaire type: F
- .1 LED Rating: 40W, 3500K, 4097 lumens output.
  - .2 Recessed direct/indirect troffer LED luminaire.
  - .3 Mounting: Indoor T-Bar ceiling recessed.
  - .4 Nominal dimensions: 1211 mm long x 603 mm wide x 152mm deep.
  - .5 LED Driver: Electronic, 120VAC, 0-10V dimming.
  - .6 Housing: Die-formed code gauge, prime cold rolled steel, heavy gauge end plates securely attached with screws for strength and rigidity and elimination of gaps.
  - .7 Finish: Durable cold rolled steel with multistage, iron phosphate pre-treatment and white enamel finish to ensure maximum bonding and rust inhibition.
  - .8 Reflectors: Indirect reflector with high reflectance baked matte white enamel finish for luminous uniformity, positively retained direct lamp shield constructed of heavy gauge perforated steel with high reflectance painted after fabrication finish and milky white overlay diffuser for visual comfort.
  - .9 CRI:  $\geq 80$
- .6 LED luminaire type: G
- .1 LED Rating: 36W, 3500K, 3766 lumens output.
  - .2 Recessed lensed troffer LED luminaire.
  - .3 Mounting: Indoor T-Bar ceiling recessed.
  - .4 Nominal dimensions: 1218 mm long x 603 mm wide x 83mm deep.
  - .5 LED Driver: Electronic, 120VAC, 0-10V dimming.
  - .6 Housing: die-formed cold rolled steel, complete with full length die-formed stiffeners and unibody endplates.
  - .7 Lens: Acrylic, high performance design for superior brightness uniformity and visual comfort, frost blend, 0.156" thick, #19 Pattern.
  - .8 CRI:  $\geq 80$
- .7 LED luminaire type: H



- .1 LED Rating: 48W, 3500K, 4444 lumens output.
  - .2 Surface « 1' x 4' » Confinement/Correctional LED luminaire.
  - .3 Mounting: indoor ceiling surface.
  - .4 Nominal dimensions: 1250 mm long x 305 mm wide x 89mm deep.
  - .5 LED driver: Electronic, 120VAC, 0-10V dimming.
  - .6 Housing: One-piece die-formed 12-18 gauge cold rolled steel body with continuous welded and ground ends to form a one-piece, seamless housing for maximum impact resistance and prevention of unauthorized fixture penetration.
  - .7 Fasteners: Stainless steel tamper-resistant TORX screws with centre pin reject.
  - .8 Hinge: Continuous stainless steel piano hinge with welded pin end to prevent removal.
  - .9 Door: One-piece cold rolled steel door frame with die-formed edges and tightly closed corners, gauge to match housing.
  - .10 Light Mask: Black fixture gasket to prevent light leaks.
  - .11 Lens: 0.125" prismatic acrylic on the fixture side and 0.125" clear polycarbonate on the environmental side, secured by thru-studs and vertically adjustable internal cold rolled steel hold-downs.
  - .12 Refer to lighting fixture schedule for approved manufacturers and models.
  - .13 CRI:  $\geq 80$
- .8 LED luminaire type: J
- .1 LED Rating: 47W, 3000K, 5225 lumens output.
  - .2 Quarter Sphere LED wall mount luminaire, IP66 rated.
  - .3 Mounting: outdoor wall surface.
  - .4 Nominal dimensions: 457mm long x 229mm wide x 229mm deep.
  - .5 LED driver: Electronic, 120VAC, mounted to die-cast aluminum back housing for optimal heat sinking, operation efficiency, and prolonged life.
  - .6 Housing: heavy-wall, die-cast aluminum with removable hinged door frame. Hinged door inset for clean mating with housing surface and secured with captive tamper-resistant TORX head fasteners, black colour.
  - .7 Optics: high-efficiency distributions, precisely designed to shape the light output, maximizing efficiency and application spacing. Type IV with back light control distribution, BUG Rating: B1-U0-G2.
  - .8 Suitable for ambient temperatures from -40°C to 40°C.
  - .9 Built-in 10kV/10kA common and differential mode surge protection.
  - .10 CRI:  $\geq 70$
- .9 LED luminaire type: K
- .1 LED Rating: 2.1W/ft., 2600K, 128 lumens/ft. output (approx. 4 lamps/ft. at 32 lumens/lamp).
  - .2 LED linear "lightstrip" with Festoon lamps (24VDC).
  - .3 Mounting: indoor surface under cabinet and behind mirror.
  - .4 Nominal dimensions: 17mm wide x 21mm deep, length as indicated.
  - .5 LED driver: Electronic, 120VAC input / 24VDC output.

- .6 Bend radius 58mm for inside or outside corner installations.
- .7 Snap in lamp holders for easy lamp replacement.
- .8 Mount with double sided tape or mounting clips.
- .9 50000 hours average lamp life.
- .10 Parallel wiring so that the loss of one bulb does not affect other bulbs.
- .11 Stamped lamp holders to indicate polarity of LED modules.
- .12 Field cuttable.
- .13 CRI:  $\geq 80$
- .10 LED luminaire type: L
  - .1 LED Rating: 57W, 3500K, 6000 lumens output.
  - .2 Industrial vapourtight LED luminaire, IP65 rated.
  - .3 Mounting: indoor wall surface.
  - .4 Nominal dimensions: 1265mm long x 178mm wide x 149mm deep.
  - .5 LED driver: Electronic, 120VAC, 0-10V dimming.
  - .6 Housing: fiberglass reinforced polyester and self-extinguishing plastic. Watertight hub for conduit entry at each end for continuous feed. Polyurethane gasketing formed in the housing to provide a continuous seamless seal for the diffuser. Sturdy stainless steel cam latches to clamp diffuser tightly for a positive seal between housing, gasketing and diffuser. Gray colour.
  - .7 Lens: internal prismatic lens with 15% DR high impact additive.
  - .8 Electrical components and luminaire cUL listed for wet locations.
  - .9 CRI:  $\geq 80$

### **PART 3**      **EXECUTION**

#### **3.1**            **INSTALLATION**

- .1      Locate and install luminaires as indicated. Install lamps in all fixtures.

#### **3.2**            **WIRING**

- .1      Connect luminaires to lighting circuits using methods as detailed or described.

#### **3.3**            **LUMINAIRE SUPPORTS**

- .1      For suspended ceiling installations support luminaires independently of ceiling support luminaires from ceiling grid in accordance with local inspection requirements.
- .2      Support luminaires mounted in continuous row once every 2.4 m.

#### **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 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical and Division 01.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **SECTION INCLUDES**

- .1      Materials and installation for emergency lighting systems.

**1.2**      **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 26 05 00 - Common Work Results – Electrical.
- .3      Section 26 05 21 - Wires and Cables (0-1000 V).
- .4      Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**1.3**      **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA)
  - .1      CSA C22.2 No.141, Unit Equipment for Emergency Lighting.

**1.4**      **SUBMITTALS**

- .1      Data to indicate system components, mounting method, source of power and special attachments.

**1.5**      **WARRANTY**

- .1      For batteries, the standard warranty period is extended to 120 months, with no-charge replacement during the first 5 years and pro-rate charge on the second 5 years from the date of Substantial Completion.

**PART 2**      **PRODUCTS**

**2.1**      **EQUIPMENT**

- .1      Emergency lighting equipment: to CSA C22.2 No.141.
- .2      Supply voltage: 120/347V dual rated.
- .3      Output voltage: 12 V dc.
- .4      Operating time: 90 Minutes (120 minutes for units located in the main electrical room and transfer switch room).
- .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 0.01V 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 and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: 7 Watt LED MR16.
- .11 Cabinet: suitable for direct mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: standard.
- .13 Auxiliary equipment:
  - .1 Auto-test and self-diagnostic complete with test switch.
  - .2 Battery disconnect device.
  - .3 AC input and DC output terminal blocks inside cabinet.

## **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: in accordance with Section 26 05 21 - Wires and Cables (0-1000 V) sized as indicated in accordance with manufacturer's recommendations.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 74 11 - Cleaning.
- .3      Section 26 05 00 - Common Work Results – Electrical.

**1.2**            **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Atomic Energy Control Board Regulations
- .3      Canadian Code for Preferred Packaging
- .4      Canadian Standards Association (CSA)
  - .1      CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
  - .2      CSA C860, Performance of Internally-Lighted Exit Signs.
- .5      National Building Code of Canada.

**1.3**            **SUBMITTALS**

- .1      Product Data:
  - .1      Submit manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .2      Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures and disposal.

**PART 2**      **PRODUCTS**

**2.1**            **SELF-POWERED UNITS**

- .1      Exit lights: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Electrical Code for Preferred Packaging guidelines.
- .2      Housing: extruded aluminum
- .3      Faceplate: High quality, clear acrylic, green running man logo with directional arrow as indicated.
- .4      Lamps: LED-2 watt power consumption.

- .5 Operation: designed for 25 years of continuous operation.
- .6 120/347V AC input, field selectable.
- .7 Operating time: 90 minutes minimum.
- .8 Recharge time: 12 hours.
- .9 Battery: sealed, maintenance free, nickel cadmium.
- .10 Charger: Solid state, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% V input variation.
- .11 Single or double face as indicated on drawings.
- .12 Finish: White.
- .13 Solid State: transfer circuit.
- .14 Signal Lights: solid state, for "AC Power On" and "high charge" condition.
- .15 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
- .16 Removable or hinged front panel for easy access to battery.
- .17 Auxiliary equipment:
  - .1 Test Switch.
  - .2 AC/DC output terminal block inside cabinet.
  - .3 RFI Suppressor.

### **PART 3**      **EXECUTION**

#### **3.1**      **INSTALLATION**

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NBCC standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Ensure that exit light circuit breaker is locked in on position.
- .4 Provide tests in accordance with Section 26 05 00 – Common Work Results - Electrical.

**3.2 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**            **DESCRIPTION**

- .1      Purpose:
  - .1      Verify operation and functional performance of all systems and equipment installed by Division 26 for compliance with "Design Intent" as described in the "Commissioning Manual" which shall be provided by the Contractor.
  - .2      Document all tests and inspections.
  - .3      Verify application of operation and maintenance manuals, as-built (record) documents, spare parts listings, special tools listing, and other items as may be specified herein for support of above systems and equipment.
  - .4      Co-ordinate and direct training to personnel for operation and maintenance of noted systems and equipment.
- .2      General:
  - .1      Furnish labour and material to accomplish complete commissioning as specified herein.
- .3      Commissioning Authority:
  - .1      The Departmental Representative shall act as the "Commissioning Authority".
- .4      Costs: Include all costs for manpower, travel, accommodations, meals, incidental expenses, etc. in the base tender price. Canada shall not pay any additional costs for "Commissioning".

**1.2**            **QUALITY ASSURANCE**

- .1      Provide for the complete commissioning periods, qualified tradesmen fully familiar with all mechanical aspects of the project.

**1.3**            **DOCUMENTATION**

- .1      Prior to the start of commissioning, assemble for the use of the commissioning team:
  - .1      Complete contract documents, including plans and specifications showing authorized revisions.
  - .2      As-Built record documents.
  - .3      Reviewed shop drawings.
  - .4      Test reports.
  - .5      Equipment start-up and certification reports.
  - .6      Records of required code authority inspections.

**1.4**            **SUBMITTALS**

- .1      Submit to the Commissioning Authority prior to Substantial Completion:
  - .1      A Training Plan describing the extent of training to be provided, expected duration, personnel involved and schedule.

## **1.5 RESPONSIBILITY OF OTHERS**

- .1 General Contractor:
  - .1 Verify completeness of the building envelope and other items which effect the proper operation of the systems.
  - .2 Assure the participation and cooperation of other divisions (mechanical, etc.) required for the commissioning process.
- .2 Mechanical Sub-Contractor and Manufacturers:
  - .1 Provide labour, material and equipment required within the scope of their specialty to facilitate the commissioning process.
  - .2 Perform tests and verification procedures required by the commissioning process when requested by the Commissioning Authority and directed by the Contractor.
- .3 Commissioning Authority:
  - .1 Provide management direction to the commissioning team during final field verification and commissioning.
- .4 Department Representative:
  - .1 Schedule Government personnel to participate in the commissioning process.
  - .2 Advise Commissioning authority regarding changes in building occupancy or usage.

## **PART 2 PRODUCTS**

### **2.1 INSTRUMENTATION**

- .1 Instrumentation for commissioning shall be provided by agency performing prior tests.

## **PART 3 EXECUTION**

### **3.1 COMMISSIONING**

- .1 Commissioning shall begin after all equipment and systems along with related equipment, systems and structure and areas are complete.

### **3.2 PRE-COMMISSIONING CHECKS**

- .1 Prior to advising Commissioning Authority that the systems are ready for final commissioning, perform and document pre-commissioning checks.
- .2 General:
  - .1 Painted finishes touched up where damaged.
  - .2 Installation complete, cleaned up and temporary tags, stickers and coverings removed.
  - .3 Safety and operating control setpoints are as designed and control sequences are as specified.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 01 33 00 – Submittal Procedures.
- .2      Section 26 05 00 – Common Work Results - Electrical.

**1.2**      **PRODUCT DATA**

- .1      Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Product data to include:
  - .1      Replacement data for motor element, thermostat and switch.
  - .2      Mounting methods.
  - .3      kW rating, voltage, phase.
  - .4      Cabinet material thicknesses.
  - .5      Physical size.
  - .6      Finish.
  - .7      Thermostat, transformer, controls where integral.

**PART 2**      **PRODUCTS**

**2.1**      **FORCED AIR HEATERS**

- .1      Forced air heaters, wall mounted commercial type as follows:
  - .1      Enclosure:
    - .1      Steel, 1.2 mm thick.
    - .2      Knockouts for 19 mm diameter conduit left, right, bottom and rear.
    - .3      Grill and frame finished coating.
  - .2      Elements and Fan:
    - .1      Mineral insulated.
    - .2      Motor: totally enclosed, shaded pole, impedance protected motor.
- .2      Capacity as indicated.

**2.2**      **CONTROLS**

- .1      Built-in tamperproof controls. 'On-Off-Fan Only' selector switch and temperature control knob.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1      Install heaters in accordance with manufacturer's instructions.
- .2      Make power and control connections.

**3.2**            **COMMISSIONING**

- .1      Perform tests in accordance with Section 26 05 00 – Common Work Requirements -  
Electrical.

**END OF SECTION**

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**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 78 00 - Closeout Submittals.

**1.2**            **REFERENCES**

- .1      Codes and standards referenced in this section refer to the latest edition thereof.
- .2      Canadian Standards Association (CSA International)
  - .1      CSA C22.2 No.46, Electric Air-Heaters.

**1.3**            **PRODUCT DATA**

- .1      Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Submit product data sheets for unit heaters. Include:
  - .1      Product characteristics.
  - .2      Performance criteria.
  - .3      Mounting methods.
  - .4      Physical size.
  - .5      kW rating, voltage, phase.
  - .6      Cabinet material thicknesses.
  - .7      Limitations.
  - .8      Colour and finish.
- .3      Submit product data sheets for unit heaters.
  - .1      Include product characteristics, performance criteria, physical size, limitations and finish.
- .4      Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

**1.4**            **CLOSEOUT SUBMITTALS**

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

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**PART 2**      **PRODUCTS**

**2.1**            **UNIT HEATERS**

- .1      Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet or vertical discharge cone type with cone diffusers as indicated.
- .2      Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.
- .3      Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.
  - .1      Built-in fan motor thermal overload protection.
- .4      Hangers: as indicated.
- .5      Elements: mineral insulated steel sheath with aluminum, continuous helical brazed fins.
- .6      Cabinet: steel, 1.6 mm thick, fitted with brackets for rod or wall mounting.
  - .1      Phosphatized and finished with 2 coats baked enamel in beige colour.

**2.2**            **CONTROLS**

- .1      Low voltage relays and transformers for connection to building control system.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1      Suspend unit heaters from ceiling or mount on wall as indicated. Provide mounting bracket as required.
- .2      Make power and control connections.

**3.2**            **COMMISSIONING**

- .1      Perform tests in accordance with Section 26 05 00 – Common Work Results-Electrical.
- .2      Test cut-out protection when air movement is obstructed.
- .3      Test fan delay switch to assure dissipation of heat after element shut down.
- .4      Test unit cut-off when fan motor overload protection has operated.
- .5      Ensure heaters and thermostatic controls operate correctly.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **GENERAL**

- .1 This section describes the extent of services to be provided for wiring of equipment supplied by others.
- .2 Within the context of this section, Others means:
  - .1 Other divisions of this specification (i.e.: Division 25 – Integrated Automation).
  - .2 The Government of Canada, as defined in the Contract.
  - .3 Other contractors supplying and installing equipment to the contract.

**1.2**      **EXTENT OF SERVICES PROVIDED**

- .1 The work of this contract is to include all power and control wiring of equipment which is provided by Division 26.
- .2 All power and control wiring above 50 V for equipment supplied by Division 25 will be the responsibility of this contractor. Coordinate with Integrated Automation contractor for exact requirements.
- .3 All control wiring 50 V and less for equipment supplied by Division 25 will be the responsibility of Division 25- Integrated Automation Contractor. Conduit and wire associated with this is the responsibility of Division 25.
- .4 All power and control wiring above 50 V associated with equipment supplied by Division 01 will be the responsibility of this contractor. Coordinate with general contractor for exact requirements. See Section 26 27 97 – Door Hardware Wiring for exceptions for wiring of door lock systems.
- .5 Final connection of all wiring to equipment provided by others (except control wiring below 50 V associated with Division 25 equipment) will be by division 26. Coordinate with the provider for connection instructions.

**1.3**      **RESPONSIBILITY OF DIVISION 26**

- .1 It is the responsibility of the Division 26 subcontractor to verify final requirements for wiring of all equipment noted. Verification of wiring requirements to include:
  - .1 Confirmation of electrical characteristics.
  - .2 Location of connection point.
  - .3 Method of connection (i.e. direct or plug-in etc.)
- .2 Obtain and become familiar with shop drawings for all relevant equipment.
- .3 No claim for extra will be entertained for wiring equipment which has been indicated, or changes to installed wiring where installation proceeded prior to verification of electrical requirements.

**PART 2**      **PRODUCTS (NOT APPLICABLE)**

**PART 3**      **EXECUTION (NOT APPLICABLE)**

**END OF SECTION**



**PART 1**      **GENERAL**

**1.1**            **RELATED REQUIREMENTS**

- .1      Section 26 05 28 – Grounding - Secondary.

**1.2**            **REFERENCES**

- .1      American National Standards Institute
  - .1      ANSI/TIA-607-C, Joint Standard - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
  - .2      Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
    - .1      TIA/EIA-606, Administration Standard for the Commercial Telecommunications Infrastructure.
  - .3      U.S. Department of Labor/Occupational Safety and Health Administration (OSHA)
    - .1      Nationally Recognized Testing Laboratory (NRTL).

**1.3**            **SYSTEM DESCRIPTION**

- .1      Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2      Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3      Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

**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      Waste Management and Disposal:
- .2      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**            **TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)**

- .1      Predrilled copper busbar, listed by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI/TIA-607-B.
- .2      Dimensions 13 mm thick, 100 mm wide, 610 mm long to: ANSI/TIA-607-B.

## **2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)**

- .1 Predrilled copper busbar, listed by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI/TIA-607-B.
- .2 Dimensions 13 mm thick, 100 mm wide, 610 mm long to: ANSI/TIA-607-B.

## **2.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS (TBC)**

- .1 Copper conductor, green insulated, size as shown on Grounding Riser Diagram to: ANSI/TIA-607-B.

## **2.4 TELECOMMUNICATIONS BONDING BACKBONE (TBB)**

- .1 Copper conductor, green insulated, size as shown on Grounding Riser Diagram to: ANSI/TIA-607-B.

## **2.5 WARNING LABELS**

- .1 Non-metallic warning labels in English and French to: ANSI/TIA-607-B.
- .2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

# **PART 3 EXECUTION**

## **3.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)**

- .1 Install TMGB in main telecommunications room on insulated supports 50 mm high at location close to electrical power panel if one is installed in same room as indicated.
- .2 Install copper bonding conductor from TMGB to alternating current equipment ground (ACEG) of serving electrical switchboard.

## **3.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)**

- .1 Install TGB in main terminal/equipment room and each telecommunications room.
- .2 Install copper bonding conductor from TGB to TMGB.

## **3.3 BONDING CONDUCTORS GENERAL**

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using grounding bushing 6 AWG copper conductor.

## **3.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS**

- .1 Install bonding conductor for telecommunications from TMGB to service equipment (power) ground.
- .2 Use approved 2 hole compression lugs for connection to TMGB.

## **3.5 TELECOMMUNICATIONS BONDING BACKBONE (TBB)**

- .1 Install TBBs from TMGB to each TGB as indicated.
- .2 Use approved 2 hole compression lugs for connection to TMGB and TGBs.

**3.6 BONDING TO TMGB**

- .1 Bond metallic raceways in main telecommunications room to TMGB using #6 AWG green insulated copper conductor.
- .2 For cables within main telecommunications room having shield or metallic member, bond shield or metallic member to TMGB using #10 AWG green insulated copper conductor.
- .3 Bond equipment cabinet located in main telecommunications room to TMGB using #6 AWG green insulated copper conductor.

**3.7 BONDING TO TGB**

- .1 Bond metallic raceways in telecommunications rooms to TGB using #6 AWG green insulated copper conductor.
- .2 For cables within telecommunications rooms having shield or metallic member, bond shield or metallic member to TGB using #10 AWG green insulated copper conductor.
- .3 Bond equipment cabinet located in telecommunications rooms to TGB using #6 AWG green insulated copper conductor.

**3.8 LABELLING**

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to: TIA/EIA-606.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .2      Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3      Section 27 10 50 - Data System.
- .4      Section 27 53 25 - Cable Television System.

**1.2**      **SYSTEM DESCRIPTION**

- .1      Telecommunications raceway system for telephone, data and cable TV consists of outlet boxes, cover plates, terminal and distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service fittings, concrete encased ducts, as indicated.
- .2      Cable trays: Wire mesh, in accordance with Section 26 05 36 – Cable Trays for Communications Systems.
- .3      Overhead ceiling distribution system within interior of building.
- .4      Telephone cables supplied as a complete and tested system.
- .5      Data system provided as a complete operational system as per Section 27 10 50 – Data Systems.
- .6      Cable TV system provided as a complete operational system as per Section 27 53 25 – Cable Television System.

**PART 2**      **PRODUCTS**

**2.1**      **MATERIAL**

- .1      Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2      Junction boxes, cabinets type E: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3      Outlet boxes flush mounted type, conduit boxes size, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .4      Fish wire: polypropylene.

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1      Install empty raceway system, including underfloor and overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, cable trays, sleeves and caps, miscellaneous and positioning material to constitute complete system, as indicated.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**      **SYSTEM DESCRIPTION**

- .1      Data system includes data outlets and wiring for building applications.
- .2      Data system equipment consists of:
  - .1      Data outlets.
  - .2      UTP cabling.
  - .3      Patch Panels.
  - .4      Modular Cords.
  - .5      Equipment Enclosures.
  - .6      Conduit System.
  - .7      System Switches
- .3      Do not provide systems switches. System switches provided by Departmental Representative.

**1.2**      **RELATED SECTIONS**

- .1      Section 01 33 00 – Submittal Procedures.
- .2      Section 26 05 34 – Conduits, Conduit Fastenings, and Conduit Fittings.
- .3      Section 27 05 28 – Pathways for Communications Systems.

**1.3**      **REFERENCES**

- .1      Codes and standards referenced in the section refer to the latest edition thereof and include all addenda.
- .2      ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises
- .3      ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard
- .4      ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- .5      ANSI/TIA-568.3-D, Optical Fiber Cabling Components Standards
- .6      ANSI/TIA-569-D, Telecommunications Pathways and Spaces
- .7      ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure
- .8      ANSI/TIA-1152-A, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

- .9 TIA TSB-162, Telecommunications Cabling Guidelines for Wireless Access Points

## **1.4 SUBMITTALS**

- .1 Shop drawings to include the following items as minimum:
- .1 Outlets.
  - .2 UTP Patch Panels.
  - .3 Labels.
  - .4 UTP Wire.
  - .5 Equipment Enclosures.
  - .6 Cable Management Equipment.

## **1.5 MAINTENANCE AND OPERATION**

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

## **1.6 WARRANTY**

- .1 Ensure each piece of equipment installed including wiring is warranted by the manufacturer to be free of defects in operation, material, and workmanship for the Manufacturer's standard period from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 OUTLETS**

- .1 Provide single or dual data outlet as indicated.
- .2 Dual flush mounted data outlet.
- .1 Two (2) 8 position CAT6+ RJ45 jacks with T568A (ISDN) wiring.
  - .2 Two (2) blank inserts.
  - .3 Colour: blue for phone, yellow for data, red for radio and grey for CCTV.
- .3 Single flush mounted data outlets:
- .1 One (1) 8 position CAT6+ RJ45 jack with T568A (ISDN) wiring.
  - .2 Three (3) blank inserts.
  - .3 Color: blue for phone, yellow for data, red for radio and grey for CCTV.

### **2.2 COVER PLATES**

- .1 Provide flush mount type to accept four (4) modular data outlets.
- .2 Indicate outlet number of "Data" cover plate. Provide labeling as indicated and to Government of Canada's requirement.

- .3 Color: White.
- .4 Construction: Thermo – plastic.

## **2.3 PATCH PANELS**

- .1 Modular (RJ45) style patch panels.
- .2 Designed for high speed data, cross connect and interconnect specifications.
- .3 48 ports per panel suitable for modular jacks.
- .4 Provide each port with a T568A (ISDN) eight pin jack as per par. 2.1.
- .5 Designed for mounting in equipment enclosure (rack). Provide one horizontal cable manager for each 48 port patch panel.
- .6 Retaining rings on panel to facilitate patch cord management.
- .7 Provide patch panels in each equipment enclosure, quantity of panels as required to connect each data outlet to a corresponding patch panel port with a minimum of 10 spare ports.

## **2.4 EQUIPMENT ENCLOSURES**

- .1 Provide 762mm W x 1067mm D x 2121mm H equipment enclosures in data rooms free standing for installation of patch panels and Government of Canada's equipment as indicated.
- .2 Extra wide multi-bay design complete with integral cable ducts suitable for accommodating large cable bundle.
- .3 Fully welded construction shall provide a static load capacity of 10,000 lbs. and a UL listed 2,500 lbs. weigh capacity.
- .4 Top and bottom of enclosure shall be 14-gauge steel, horizontal braces shall be 1/8" thick steel, all structural elements shall be finished in durable black powder coat.
- .5 Enclosure shall include a vented, locking and latching rear door.
- .6 Enclosure shall come equipped with 10" fan top and fan guard for ventilation, one pair of cable ducts with solid steel hinged doors and 4-point magnetic closure pre-installed in front, two pairs of wide 11-gauge rackrail labeled with EIA standard rackspace increments with cage-nut style mounting holes, finished in black e-coat, and vented rear door.
- .7 Enclosure shall have a removable rear knockout panel with 1/2", 3/4", 1", and 1-1/2" electrical knockouts installed in base, and removable split rear knockout panels with electrical knockouts and BNC knockouts for UHF/VHF antennae installed in top.



- .8 Grounding and bonding studs shall be zinc plated 1/4-20x1 threaded, installed two each in base and top of enclosure.
- .9 Provide seismic compliant floor anchor brackets.
- .10 Enclosure shall be manufactured by an ISO 9001 and ISO 14001 registered company.
- .11 Enclosure shall be warrantied to be free from defects in material or workmanship under normal use and conditions for the lifetime of the enclosure.
- .12 Coordinate actual location of patch panel with Departmental Representative.
- .13 Supply and install a # 6 AWG insulated ground wire from the room ground bus to the enclosure grounding and bonding stud.
- .14 Enclosure capacity: 44RU

## **2.5 CABLE MANAGEMENT**

- .1 Cable management at equipment enclosures:
  - .1 Horizontal cable management channels, one for every 48 ports, five (5) per enclosure minimum.
  - .2 Vertical cable management channels two (2) per enclosure minimum.
- .2 Cable management in accessible ceiling spaces:
  - .1 Cable bundle support mounted to steel structure with beam clamps as required. Support to be 50 mm diameter J-Hook. Run cables to nearest zone conduit back to Data room.
  - .2 Provide quantity as required to support all loose cables at 1000 mm spacing up to point of entry into zone conduit system.
  - .3 Provide support for individual cables using caddy clip at 1000 mm spacing.

## **2.6 MODULAR CORDS**

- .1 Provide modular cords, with factory-installed male plug at both ends to mate with RJ-45 jack. 24 AWG solid copper conductor, Category 6, Bonded-Pair, 4 Pair, T568A wired.
- .2 Quantity: Two colour yellow for each data outlet, plus 25% spare. Two colour blue for each voice outlet, plus 25% spare. Two colour red for each radio outlet, plus 25% spare. Two colour grey for each CCTV outlet, plus 25% spare.
- .3 Cords must be from same manufacturer as connectivity components.
- .4 Cord lengths to be 3 m for each colour at all workstations.
- .5 Cord lengths to be 50% 0.6 m and 50% 1.2 m for each colour at the Equipment Enclosure located in the LAN room.

## **2.7 LABELS**

- .1 Provide indicating labels on UTP wiring and outlet assemblies.
- .2 Telecom Outlet Labeling:
  - .1 All MMO ports shall be identified by an alphanumeric code that will coincide with the associated Telecom Room (TR), racks, patch panel and port as follows:
    - .1 All faceplates are to be equipped with a Telecom Room identifier label (MTR, TR1-1, etc.);
    - .2 All Telecom outlet ports are to be identified using a numeric code that coincides with the applicable patch panel port. As such, a port labeled as 1-24-23 indicates that the other end of the cable is terminated to Rack 1, Patch Panel 24, and Port 23. Refer to the Typical Faceplate Labeling detail on the drawings.
  - .3 Labeling on wire from outlet to patch panel: heat shrink labels sized for data cables indicating data outlet # and port # on respective ends.
  - .4 Coordinate labeling with Departmental Representative prior to fabrication.

## **2.8 UTP WIRING**

- .1 4 pair, 23 gauge, solid conductor, unshielded twisted pairs, CSA FT6 fire rating, Category 6, guaranteed for 2.4 Giga bytes per second transmission/receiving rate.
- .2 Provide one cable from each single outlet back to patch panel (two cables from each dual data outlet back to patch panel). Colour: Blue for phone, yellow for data, red for radio and grey for CCTV.

## **2.9 CONDUIT SYSTEMS**

- .1 Install conduit systems and pull boxes for data wiring including:
  - .1 Vertical stubs in walls from outlets into accessible ceiling space.
  - .2 Zone conduits as indicated on drawings for collection of UTP wiring in ceiling spaces.
  - .3 Pull boxes.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install data system wiring and components.
- .2 Install patch panels in equipment enclosures at data closet locations as indicated.
- .3 Terminate UTP and fiber optic cables at outlets and patch panel as indicated. Ensure that the minimum number of twists per inch in the cable pairs is maintained at each connection point.

- .4 Ensure that manufacturer's bending radius limitations are adhered to.
- .5 Protect cables from damage during installation.
- .6 Zone conduits and cable trays to be installed, as indicated, running back to patch panel location. Bond the data room end of all zone conduits and cable trays to the building ground system.
- .7 Conduits to be run from data outlets to cable trays in ceiling space. Provide insulated conduit bushing at open end of wall stub-up.
- .8 Turn over all modular cords to Departmental Representative.

### **3.2 CONDUIT SYSTEM RESTRICTIONS**

- .1 Do not provide conduit raceways that exceed 30 m or contain more than two 90<sup>o</sup> bends (or equivalent) between pull points or pull boxes. Advise the Departmental Representative in advance of any such potential installations. The Departmental Representative will then provide clarification.
- .2 Do not provide pull boxes in lieu of conduit bends.
- .3 LB connectors not permitted.
- .4 Provide inside radius bends to a minimum of 6 times the internal diameter for conduits 50 mm and smaller. For larger conduits provide inside radius bends to a minimum of 10 times the internal diameter of the conduit.
- .5 Ensure conduits terminations are free from sharp edges and fitted with insulated bushings.
- .6 Ream individual lengths of conduit to remove sharp edges.
- .7 Provide sufficient conduit size to permit maximum 50% fill capacity.

### **3.3 TESTING GENERAL**

- .1 Cabling and connectors to be tested by an experienced company employing trained technicians with minimum 5 years experience in data cabling industry. Experience to be acceptable to the Departmental Representative.

### **3.4 TESTING UTP CABLING**

- .1 System to meet continuity and attenuation tests outlined in IBDN Testing Note: IBDN-TESTS-9104.
- .2 Category 6 cable to meet ANSI standard x3T9.5 (capable of data transmission up to 2.4 G. bps).
- .3 Perform system and channel tests after UTP cable installation to ensure that installation meets standard indicated above and values indicated in the IBDN design guide issue 2

(IBDN-DG-9202). Tests to be performed using a Level IV tester. Minimum tests to be performed.

- .1 Continuity.
- .2 Attenuation.
- .3 Near and Crosstalk.
- .4 Resistance.
- .5 Pair Assignment Test.
- .6 Low Band Noise.
- .7 High Band Noise.
- .8 Mid Band Noise.
- .9 Length of Cable.
- .10 Return loss
- .11 ELFEXT
- .12 Propagation delay.
- .13 Deby skew.

Perform permanent link tests to cover all equipment wiring including patch panels and line cords. Perform tests from data closet outwards to data outlet line cord.

- .4 Provide to construction manager written copy of the testing sequence to be performed, testing equipment to be used, and standards to which cable is being tested.
- .5 Provide a written report to the Departmental Representative indicating each cable tested and the results of the testing. Provide printout from the Level IV tester for each cable.
- .6 Replace cable and/or connection equipment that fails tests.
- .7 Provide additional testing in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **DESCRIPTION OF SYSTEM**

- .1 Complete system of conduit raceways, outlet boxes, outlet assemblies, coverplates distribution amplifier, splitters/attenuators and coaxial cable as described herein.

**1.2**            **WORK INCLUDED IN THIS CONTRACT**

- .1 The work of this contract shall include:
  - .1 Provision of all raceway systems indicated.
  - .2 Provision of all cable and terminations as indicated.
  - .3 Provision of sectional boxes for television outlets
  - .4 Provision of distribution amplifier, splitter/attenuators as described.

**1.3**            **RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 01 91 13 - General Commissioning (Cx) Requirements.
- .4 Section 26 05 00 - Common Work Results – Electrical.
- .5 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings.

**1.4**            **TRAINING**

- .1 Arrange and pay for on-site lectures and demonstrating by system manufacturer to train designated personnel in the use and maintenance of the system.

**1.5**            **WARRANTY**

- .1 Ensure equipment installed is warranted by the manufacturer to be free of defects in operation, material and workmanship for a period of one (1) year from date of Substantial Completion.

**PART 2**      **PRODUCTS**

**2.1**            **OUTLETS**

- .1 Outlets complete with one (1) G/F connector mounted in stainless steel wall plate. Impedance: 75 Ohm, Frequency Band: SUB/VHF/FM/CATV/UHF, RFI Shielded Circuitry.

## **2.2 DISTRIBUTION SPLITTERS/ATTENUATORS**

- .1 Professional quality splitter blocks with multiple taps, number to suit application. Attenuation rating to suit application. Performance 5 to 1000 MHz, Die Cast Housing, RFI Shielding: 120 dB, Built-in Ground Block.

## **2.3 AMPLIFIER**

- .1 Broadband RF amplifier for CATV signal boost. Wall mount at CATV equipment board in room 131B. Continuous coverage of all frequencies from 40 MHz to 1000 MHz to cover the full VHF and UHF bands as well as all CATV channels. Discrete Push-Pull Amplifier Stages. Front Panel Gain Control with 35 dB of operational gain, a gain control range of 16 dB and superior distortion performance. Chassis designed for superior heat dissipation. Line Transient Protection. Low 40 MHz Band Edge.

## **2.4 COAXIAL CABLE**

- .1 Coaxial cable: 75 Ohm, RG-6/U type, 18 AWG Solid .040" bare copper-covered steel conductor, gas-injected foam polyethylene insulation, aluminum braid shield (60% coverage), black PVC jacket, riser rated for -40° C to + 80° C.

## **2.5 CABLE SUPPORT**

- .1 Provide support for coaxial cables in accordance with Section 27 10 50 – Data Systems.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install raceway system, including fish wire, cable, splitters, outlet boxes, pull boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute a complete functional system.
- .2 Install one run of cable from each outlet to splitters as indicated. Install trunk cable in corridor.
- .3 Run distribution cables from splitter locations to TV plywood backboard.
- .4 Install amplifier, and splitter/attenuators.
- .5 Provide jumper cables suitable to extend T.V. signal from each outlet to future television sets. Length: 2 meters; Type: Flexible T.V. co-axial cable; turn over to the Departmental Representative.

### **3.2 FIELD QUALITY ONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical and Section 01 91 13 – General Commissioning (Cx) Requirements.

- .2 Test coaxial for:
  - .1 Continuity.
  - .2 Attenuation.
- .3 Test STP cables for:
  - .1 Continuity.
  - .2 Attenuation.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **DESCRIPTION OF WORK**

- .1      This section covers the provision of power for door locks and conduit for 24 VDC hardware wiring.
- .2      Door lock equipment provided by the door hardware supplier.
- .3      Card access equipment supplied and installed by Departmental Representative.
- .4      Low voltage (24VDC) wiring supplied & installed by Division 26.

**1.2**            **RELATED SECTIONS**

- .1      Section 08 71 00 - Door Hardware.
- .2      Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**1.3**            **EQUIPMENT SUPPLIED BY DIVISION 26**

- .1      Provide all 120 VAC wiring in conduit system for power supply as indicated.
- .2      Provide conduits and wiring for door hardware, as indicated.

**1.4**            **COORDINATION**

- .1      Co-ordinate with door hardware supplier to ensure that equipment, boxes, wiring and conduit are located correctly.

**1.5**            **CERTIFICATE OF COMPLIANCE**

- .1      Provide a letter of verification stating that the system has been checked out and is operational in advance of the Substantial Completion inspection.

**PART 2**      **PRODUCTS (NOT APPLICABLE)**

**PART 3**      **EXECUTION**

**3.1**            **EXECUTION**

- .1      Install 120 VAC power to door power supplies.
- .2      Install conduit system c/w 24 VDC wiring as shown on the drawings. Wiring to have 3 m coiled loops at each end for future terminations by Departmental Representative.

**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.

**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 the Province of Nova Scotia, Canada.
  - .2      Indicate on shop drawings:
    - .1      Detail assembly and internal wiring diagrams for control units.
    - .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 indoors 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.
- .4 Develop Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse by manufacturer and return of pallets, crates, padding, packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **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 alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to fire department.
- .3 Zoned, non-coded single stage.
- .4 Modular in design to allow for future expansion.
- .5 Operation of system shall not require personnel with special computer skills.
- .6 System to include:

- .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.
- .2 Power supplies.
- .3 Initiating/input circuits.
- .4 Output circuits.
- .5 Auxiliary circuits.
- .6 Wiring.
- .7 Manual and automatic initiating devices.
- .8 Audible and visual signalling devices.
- .9 End-of-line resistors.
- .10 Local and Remote annunciators.
- .11 Event log memory chip.
- .12 Historic event recorder.
- .7 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .8 Power supply: to CAN/ULC-S524.
- .9 Audible signal devices: to CAN/ULC-S524.
- .10 Visual signal devices: to CAN/ULC-S526.
- .11 Control unit: to CAN/ULC-S527.
- .12 Manual pull stations: to CAN/ULC-S528.
- .13 Thermal detectors: to CAN/ULC-S530.
- .14 Smoke detectors: to CAN/ULC-S529.
- .15 Smoke alarms: to CAN/ULC-S531.
- .16 Regulatory Requirements:
  - .1 To TBS Fire Protection Standard.
  - .2 System components: listed by ULC and comply with applicable provisions of NBC, and meet requirements of local authority having jurisdiction.

## 2.2

### **SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY**

- .1 Actuation of any alarm initiating device to:
  - .1 Cause electronic latch to lock-in alarm state at central control unit.
  - .2 Indicate zone of alarm at central control unit and remote annunciator.
  - .3 Cause audible signalling devices to sound continuously throughout building and at central control unit.
  - .4 Transmit signal to fire department via master fire alarm box.
  - .5 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.
  - .6 Cause fire doors and smoke control doors, if normally held open, to close automatically.
  - .7 Cause elevators to return to floor of egress, or to alternate floor, as required.

- .2 Acknowledging alarm: indicated at central control unit.
- .3 Ensure that it is possible to silence signals by "alarm silence" switch at control unit, after 60 seconds period of operation.
- .4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .5 Actuation of supervisory devices to:
  - .1 Cause electronic latch to lock-in supervisory state at central control.
  - .2 Indicate respective supervisory zone at central control unit and at remote annunciator display.
  - .3 Cause audible signal at central control unit to sound.
  - .4 Activate common supervisory sequence.
- .6 Resetting alarm and supervisory device not to return system indications/functions back to normal until control unit has been reset.
- .7 Trouble on system to:
  - .1 Indicate circuit in trouble at central control unit.
  - .2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.
- .8 Trouble on system: suppressed during course of alarm.
- .9 Trouble condition on any circuit in system not to initiate alarm conditions.

## 2.3 CONTROL PANEL

- .1 Central control unit (CCU).
  - .1 Suitable for DCLB and DCLA communication style: to CAN/ULC-S524.
  - .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
  - .3 Minimum capacity of 500 addressable monitoring and 250 addressable control/signal points. Points may be divided between 2 communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of other channel.
  - .4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.
  - .5 Integral power supply, battery charger and standby batteries.
  - .6 Basic life safety software: retained in non volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (i.e. zone labels, priorities) and changing of system operation software.
  - .7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.

- .8 Support up to 4 RS-232-C I/O ports. CCU output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.
- .9 Equipped with software routines to provide Event-Initiated-Programs (EIP); change in status of one or more monitor points, may be programmed to operate any or all of system's control points.
- .10 Software and hardware to maintain time of day, day of week, day of month, month and year.
- .11 Software to operate variable sensitivity addressable smoke detectors and announce their status and sensitivity settings at control panel.

## **2.4 POWER SUPPLIES**

- .1 120 V, 60 Hz as primary source of power for system.
- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .6 Standby batteries: sealed, maintenance free.
- .7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

## **2.5 INITIATING/INPUT CIRCUITS**

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit.
- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".
- .4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit.
- .5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

## **2.6 ALARM OUTPUT CIRCUITS**

- .1 Alarm output circuit: connected to signals, wired in class B configuration to central control unit.
  - .1 Signal circuits' operation to follow system programming; capable of sounding horns continuously 2 A, 24 VDC; fuse-protected from overloading/overcurrent.
  - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

## **2.7 AUXILIARY CIRCUITS**

- .1 Auxiliary contacts for control functions.
- .2 Actual status indication (positive feedback) from controlled device.
- .3 Alarm supervisory and trouble on system to cause operation of programmed auxiliary output circuits.
- .4 2 sets of separate contacts for elevator capture to main floor of egress and to alternate floor of egress.
- .5 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .6 Fans: stagger-started upon system reset; timing circuit to separate starting of each fan or set of fans connected to auxiliary contact on system.
  - .1 Timing circuit: controlled by CCU.
- .7 Auxiliary circuits: rated at 2 A, 24 Vdc or 120 Vac, fuse-protected.

## **2.8 WIRING**

- .1 Twisted copper conductors: rated 300 V, FAS105.
- .2 To initiating circuits: 18 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.

## **2.9 MANUAL ALARM STATIONS**

- .1 Addressable manual pull station.
  - .1 Pull lever, break glass rod, surface wall mounted type, single action, single 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 Double-action with clear Polycarbonate tamper resistant protective cover where indicated.

## **2.10 AUTOMATIC ALARM INITIATING DEVICES**

- .1 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57 and 88 degrees C, rate of rise 8.3 degrees C per minute.
  - .1 Electronics to communicate detector's status to addressable module/transponder.
  - .2 Detector address to be set on detector base in field.
- .2 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.

- .3 Addressable variable-sensitivity smoke detectors.
  - .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.
  - .4 Sensitivity settings: 7 settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
  - .5 Ability to annunciate minimum of 2 levels of detector contamination automatically with trouble condition at control panel.

## **2.11 AUDIBLE SIGNAL DEVICES**

- .1 Horns: 110 db, 24 V dc.

## **2.12 VISUAL ALARM SIGNAL DEVICES**

- .1 Strobe type: flashing, 24 V dc.
- .2 Designed for surface mounting on ceiling and walls as indicated.

## **2.13 END-OF-LINE DEVICES**

- .1 End-of-line devices to control supervisory current in signalling circuits, sized to ensure correct supervisory current for each circuit. Open 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.

## **2.14 REMOTE ANNUNCIATORS**

- .1 Remote alphanumeric type, with designation cards to indicate zones.
- .2 Display:
  - .1 Alarms and troubles for alarm initiating circuits.
  - .2 Supervisory alarms and troubles for supervisory initiating circuits.
  - .3 Common system trouble.
- .3 Trouble buzzer:
  - .1 Acknowledging trouble at main panel to silence trouble buzzers in system.
- .4 Supervised, with LED test button and alarm and trouble acknowledge button.
- .5 Minimum wiring configuration with main panel.

## **2.15 PROTECTIVE CAGE**

- .1 Provide approved factory manufactured protective cage for protection of smoke detectors in cells as indicated. Smoke detectors shall be compatible with the protective cage and the fire alarm control panel where protective cages are required.
- .2 Approved Protective Cages:
  - .1 Vipond model KSFDG-002, to protect Notifier Smoke Detector model FSL-851A.
  - .2 Simplex-Grinnell model 2098-9829C, to protect Smoke Detector models 4098-9601C, 4098-9701C, 4098-9714C and 2098-9201C. Rotate guard so that conduit

port is blocked by the perforated tab on the mounting plated. Must be used in air velocities greater than 3 m/min. as a condition of ULC approval.

- .3 GE Security (Edwards) model 6255-004, to protect Smoke Detector models 6249C, 6250C, 6269C, 6270C and SIGA-IPHS. Maximum sensitivity setting recommended for SIGA-IPHS. Rotate conduit entrance cover 90° to ensure no opening exists when installed. Must be used in air velocities greater than 9 m/min. as a condition of ULC approval.
- .4 Notifier (Honeywell) model Smoke G1A-2, to protect Notifier Smoke Detector model FSL-851A.
- .3 General Protective Cage notes:
  - .1 During installation, use security sealant to fill any space between the back of the mounting plate and the ceiling surface.
  - .2 ULC listing of protective cages is typically detector-specific.
  - .3 Surface conduit not approved.
  - .4 All grilles/protective cages must be stamped with manufacturer and model number on the face plate.

## **2.16 AS-BUILT RISER DIAGRAM**

- .1 Fire alarm system riser diagram: in glazed frame on black lamicaid sheet with bevelled edges, white lettering and designations, minimum size 600 x 600 mm.

## **2.17 ANCILLARY DEVICES**

- .1 Remote relay unit to initiate fan 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 central control unit and connect to ac power supply.
- .3 Install manual alarm stations and connect to alarm circuit wiring.
- .4 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.



- .5 Connect alarm circuits to main control panel.
- .6 Install horns and visual signal devices and connect to signalling circuits.
- .7 Connect signalling circuits to main control panel.
- .8 Install end-of-line devices at end of alarm and signalling circuits.
- .9 Install remote annunciator panels and connect to annunciator circuit wiring.
- .10 Install door releasing devices.
- .11 Install remote relay units to control fan shut down.
- .12 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .1 Install smoke detector protective cages as per manufacturer's instructions and as indicated. Use security sealant to fill any spaces between the back of the mounting plate and the ceiling surface.
- .13 Connect fire suppression systems to control panel.
- .14 Splices are not permitted.
- .15 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .16 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .17 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 smoke detectors, sprinkler system, transmit alarm to control panel and actuate general alarm and ancillary devices.
  - .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 DCLB:
    - .1 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals on line side of single open-circuit fault condition imposed near electrically most remote device on 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 DCLB addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near electrically most remote device on 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 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
  - .2 Place materials defined as hazardous or toxic waste in designated containers.

### **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.

### **3.7 MAINTENANCE**

- .1 Provide individual price on tender form for subsequent PROM re-burns. Price: good for 3 years from date of project completion.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 35 43 - Environmental Procedures.
- .4 Section 31 05 16 - Aggregate Materials.
- .5 Section 32 91 19.13 – Topsoil Placement and Grading.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM): latest edition:
  - .1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D422, Standard Test Method for Particle-Size Analysis of Soils.
  - .4 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m<sup>3</sup>).
  - .5 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian Standards Association (CSA International); latest edition:
  - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005):
    - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
  - .2 CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
  - .3 Government of Newfoundland and Labrador - Department of Transportation and Works Highway Design Division - Highways Specification Book (Latest Edition).
- .3 Canadian Environmental Protection Act (Available on-line Government of Canada Website).
- .4 Newfoundland and Labrador Environmental Act and Regulations.
- .5 Government of Newfoundland and Labrador - Department of Transportation and Works:
  - .1 Government of Newfoundland and Labrador - Department of Transportation and Works Highway Design Division - Highways Specification Book (Latest Edition).
- .6 Occupational Health & Safety Act - Province of Newfoundland and Labrador.

### 1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation:
  - .1 Rock: solid material in excess of 1.00 m<sup>3</sup> and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m<sup>3</sup> bucket. Frozen material not classified as rock.
  - .2 Common excavation: excavation of materials of whatever nature up to required depth, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Fill material: rock fill meeting the requirements specified in Section 31 05 16 - Aggregate Materials.
- .6 Unsuitable materials:
  - .1 Weak, chemically unstable, and compressible materials.
  - .2 Frost susceptible materials:
    - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136.
    - .2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45
    - .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.
- .7 Backslope: the slope in a cut between the invert of the roadside ditch and the point where the slope intersects original ground.
- .8 Rock Face: the vertical or near vertical face between the top of the existing rock surface and the designated rock or ditch grade line.

### 1.4 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Where the Consultant is employee of the Contractor, submit proof that Work by the Consultant is included in Contractor's insurance coverage.
- .3 Submit design and supporting data at least two (2) weeks prior to beginning Work.
- .4 Design and supporting data submitted to bear stamp and signature of qualified Professional Engineer registered or licensed in the Province of Newfoundland and Labrador.

- .5 Keep design and supporting data on site.
- .6 Engage services of a qualified Professional Engineer who is registered or licensed in the Province of Newfoundland and Labrador in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .7 Do not use soil material until written report of soil test results are reviewed and approved by the Departmental Representative.
- .8 Health and Safety Requirements:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

## **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

## **1.6 EXISTING SITE CONDITIONS**

- .1 Contractor to visit site prior to submission of tender.

## **1.7 MEASUREMENT AND PAYMENT**

- .1 No measurement for payment shall be made for items under this section. Include all costs in the Lump Sum Amount on the Combined Price Form.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Granular Backfill: properties to Section 31 05 16 - Aggregate Materials.
- .2 Bedding Material: properties to Section 31 05 16 - Aggregate Materials.

## **Part 3 Execution**

### **3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Follow Section 01 35 43 – Environmental Procedures.
- .2 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with the Newfoundland and Labrador Environment Act and Regulations, and in accordance with authorities having jurisdiction, whichever is more stringent.
- .3 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### **3.2 SITE PREPARATION**

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

### **3.3 PREPARATION/PROTECTION**

- .1 Protect existing features in accordance with applicable local regulations.
- .2 Keep excavations clean, free of standing water, snow, ice and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to the Departmental Representative approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

### **3.4 STOCKPILING**

- .1 Stockpile fill materials in areas designated by the Departmental Representative:
  - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

### **3.5 DEWATERING AND HEAVE PREVENTION**

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for the Departmental Representative's approval details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur:
  - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures to approved collection areas and in a manner not detrimental to public and private property, or portion of Work completed or under construction:
  - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

### **3.6 EXCAVATION**

- .1 Advise the Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.

- .2 Excavate to lines, grades, elevations, and dimensions as directed by the Departmental Representative.
- .3 Stripping: Strip topsoil/organic material for salvage as per Section 32 91 19.13 – Topsoil Placement and Grading.
- .4 All surplus excavated material shall be stockpiled at locations as directed by the Departmental Representative.
- .5 One lane traffic must be kept at all time during construction and two lane traffic must be reinstated during non-construction hours.
- .6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by the Departmental Representative.
- .7 Restrict vehicle operations directly adjacent to open trenches.
- .8 Dispose of surplus by stockpiling on site as directed by the Departmental Representative.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .11 Notify the Departmental Representative when bottom of excavation is reached.
- .12 Obtain the Departmental Representative's approval of completed excavation.
- .13 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by the Departmental Representative.
- .14 Correct unauthorized over-excavation as follows:
  - .1 Fill over excavated space with approved fill compacted to not less than 100% of Standard Proctor maximum dry density.
  - .2 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .15 Hand trim, make firm and remove loose material and debris from excavations:
  - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
  - .2 Clean out rock seams and fill with concrete mortar or grout to approval of the Representative.

### **3.7 FILL TYPES AND COMPACTION**

- .1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D698:
  - .1 Backfilling: compact to 98%.

### **3.8 BACKFILLING**

- .1 Do not proceed with backfilling operations until completion of following:
  - .1 The Departmental Representative has inspected and approved installations.
  - .2 The Departmental Representative has inspected and approved of construction below finish grade.

- .3 Inspection, testing, approval, and recording location of underground utilities.
- .4 Removal of concrete formwork.
- .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 200 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
  - .1 Place bedding and surround material as specified elsewhere.
  - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
  - .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.2 m.
  - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
    - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from the Departmental Representative.
    - .2 If approved by the Departmental Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by the Departmental Representative.
- .6 Place fill in areas as indicated.
- .7 Consolidate and level unshrinkable fill with internal vibrators.
- .8 Install drainage system in backfill as directed by the Departmental Representative.

### **3.9 RESTORATION**

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 31 05 16 - Aggregate Materials.

**1.2 DESCRIPTION**

- .1 This section specifies requirements for supplying, producing and placing crushed quarry stone as a granular subbase (Granular "B" Gravel, except for gradation adjustment) to lines, grades and typical cross sections indicated, or as directed by Departmental Representative.

**1.3 REFERENCES**

- .1 Government of Newfoundland and Labrador - Department of Transportation and Works:
  - .1 Government of Newfoundland and Labrador - Department of Transportation and Works Highway Design Division - Highways Specification Book (Latest Edition) - Division 3 - Pavement, Selected Granular Base Course and Related Materials - Section 315 - Selected Granular Base Course - Granular "B".
- .2 ASTM International - most recent edition:
  - .1 ASTM C117, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - .3 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .4 ASTM D422, Standard Test Method for Particle-Size Analysis of Soils.
  - .5 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>3</sup>) (600kN-m/m<sup>3</sup>).
  - .6 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .3 Ministry of Transportation of Ontario:
  - .1 LS-618 Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.5 MEASUREMENT FOR PAYMENT**

- .1 No measurement for payment shall be made for items under this section. Include all costs in the Lump Sum Amount on the Combined Price Form.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Granular Sub-Base: to meet Granular "B" Gravel and the following requirements:
  - .1 Granular sub-base to be quarried, crushed rock.
  - .2 Gradations to be within limits as indicated for Granular "B" in Government of Newfoundland and Labrador - Department of Transportation and Works Highway Design Division - Highways Specification Book (Latest Edition) - Division 3 - Pavement, Selected Granular Base Course and Related Materials - Section 315 - Selected Granular Base Course.
  - .3 Granular sub-base to be supplied by Contractor.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of subgrade are acceptable for Granular Sub-base installation in:
  - .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 approval to proceed from Departmental Representative.

**3.2 PLACING**

- .1 Place Granular Sub-base after subgrade is inspected and approved by the Departmental Representative.
- .2 Construct Granular Sub-base to depth and grade in areas indicated on the plans or as directed by the Departmental Representative.
- .3 Ensure no frozen material is used in placing.
- .4 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place Granular Sub-base materials using methods which do not lead to segregation or degradation.
- .7 Place material to full width in uniform layers not exceeding 200 mm compacted thickness. The Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace portion of layer in which material has become segregated during spreading.

### **3.3            COMPACTION**

- .1     Compaction equipment to be capable of obtaining required material densities.
- .2     Compact to density of not less than 100% maximum dry density in accordance with ASTM D698.
- .3     Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4     Apply water as necessary during compaction to obtain specified density. If aggregate is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
- .5     In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by the Departmental Representative.
- .6     Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

### **3.4            CLEANING**

- .1     Leave work area clean at end of each day.

### **3.5            SITE TOLERANCES**

- .1     Finished sub-base surface to be within 25 mm of elevation as indicated but not uniformly high or low.

### **3.6            PROTECTION**

- .1     Maintain finished Granular Sub-base in condition conforming to this section until succeeding base is constructed, or until Granular Sub-base is accepted by the Departmental Representative.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 32 11 16.01 - Granular Sub-Base.

**1.2 REFERENCES**

- .1 Government of Newfoundland and Labrador - Department of Transportation and Works:
  - .1 Government of Newfoundland and Labrador - Department of Transportation and Works Highway Design Division - Highways Specification Book (Latest Edition) - Division 3 - Pavement, Selected Granular Base Course and Related Materials - Section 315 - Selected Granular Base Course.
  - .2 American Society for Testing and Materials (ASTM) - most recent edition:
    - .1 ASTM C117, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
    - .2 ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
    - .3 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
    - .4 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
    - .5 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>3</sup>) (600kN-m/m<sup>3</sup>).
    - .6 ASTM D2922- Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
  - .3 Canadian General Standards Board (CGSB):
    - .1 CAN/CGSB-8.1, Sieves, Testing, Woven-Wire, Inch Series.
    - .2 CAN/CGSB-8.2-, Sieves, Testing, Woven Wire, Metric.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 MEASUREMENT AND PAYMENT**

- .1 No measurement for payment shall be made for items under this section. Include all costs in the Lump Sum Amount on the Combined Price Form.

**Part 2 Products**

**2.1 MATERIALS**

.1 Granular base - Granular "A": material in accordance with Government of Newfoundland and Labrador - Department of Transportation and Works Highway Design Division - Highways Specification Book (Latest Edition) - Division 3 - Pavement, Selected Granular Base Course and Related Materials - Section 315 - Selected Granular Base Course and the following requirements:

- .1 Crushed quarried stone.
- .2 Granulations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB - 8.1:

.1 Granulation to:

Sieve Designation	% Passing (Base Type 1)
19 mm	100
15.9 mm	-
12.5 mm	-
9.5 mm	50-80
4.75 mm	35-60
2.00 mm	-
1.20 mm	15-35
0.425 mm	-
0.180 mm	-
0.075 mm	3-6

- .3 Los Angeles degranulation: to ASTM C131. Maximum % loss by weight 35.
- .4 Crushed particles: at least 100% of particles by mass within each of following sieve designation ranges to have at least 1 (one) freshly fractured face. Materials to be divided into ranges using methods of ASTM C136:

<u>Passing</u>	<u>Retained on</u>
50 mm	to 25 mm
25 mm	to 19 mm
19 mm	to 4.75 mm

- .5 Soaked CBR to ASTM D1833, min 100 when compacted to 100% of ASTM D1557.

**Part 3 Execution**

**3.1 INSPECTION OF UNDERLYING SUB-BASE**

.1 Place granular base after surface is inspected and approved by Departmental Representative.

**3.2 PLACING**

.1 Construct granular base to depth and grade in areas indicated on the plans or as directed by the Departmental Representative.

- .2 Ensure no frozen material is used in placing.
- .3 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice.
- .4 Begin spreading base material on crown line or high side of one-way slope.
- .5 Place granular base materials using methods which do not lead to segregation or degradation.
- .6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .7 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .8 Compacted shouldering to be flush with asphalt concrete surface.
- .9 Hand work will be required to form base for asphalt concrete gutters/offtakes.
- .10 Place, hand rake and compact new shoulder material under and behind guiderail.

### **3.3 COMPACTION EQUIPMENT**

- .1 Vibratory compaction equipment must be used and capable of obtaining required densities on aggregates on project.

### **3.4 COMPACTING**

- .1 Density of granular base course will be determined according to ASTM D2922.
- .2 Compaction equipment to be capable of obtaining required material densities.
- .3 Compact to density not less than 100% maximum dry density in accordance with ASTM D698.
- .4 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .5 Apply water as necessary during compacting to obtain specified density. If aggregate is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
- .6 In areas not accessible to rolling equipment, compact to specified density with vibratory mechanical tampers approved by the Departmental Representative.
- .7 Equipment:
  - .1 Compaction equipment to be capable of obtaining required material densities.
  - .2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from the Departmental Representative before use.
  - .3 Equipped with device that records hours of work, not motor running hours.

### **3.5 FINISH TOLERANCES**

- .1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.
- .2 Density of Granular Base Course will be determined according to ASTM2922.

- .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

**3.6 CLEANING**

- .1 Leave Work area clean at end of each day.

**3.7 PROTECTION**

- .1 Maintain finished base in condition conforming to this section until succeeding material is applied or until acceptance by Departmental Representative.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.2 DESCRIPTION**

- .1 This section covers asphalt concrete on reconstructed roadbed and shall meet the general requirement of Government of Newfoundland and Labrador – Department of Transportation and Works Highway Design Division – Works Specification Book (Latest Edition) – Division 3 – Pavement, Selected Granular Base Course and Related Materials – Section 330 – Hot Mix Asphaltic Concrete.

**1.3 REFERENCES**

- .1 Government of Newfoundland and Labrador – Department of Transportation and Works:
  - .1 Government of Newfoundland and Labrador – Department of Transportation and Works Highway Design Division – Works Specification Book (Latest Edition) – Division 3 – Pavement, Selected Granular Base Course and Related Materials – Section 330 – Hot Mix Asphaltic Concrete.
- .2 AASHTO:
  - .1 AASHTO T283 - Standard Method of Test for Resistance of Compacted Bituminous Mixture to Moisture Damage.
  - .2 AASHTO P66 Standard Practice for Grading or Verifying the Performance Grade of an Asphalt Binder.
  - .3 AASHTO TP33- Standard Test Method for Uncompacted Void Content of Fine Aggregate.
- .3 ASTM International - most recent edition:
  - .1 ASTM C88, Test method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
  - .2 ASTM C117, Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.
  - .3 ASTM C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.
  - .4 ASTM C128, Test Method for Specific Gravity and Absorption of Fine Aggregate.



- .5 ASTM C131, Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- .6 ASTM C136, Method for Sieve Analysis of Fine and Coarse Aggregates.
- .7 ASTM D156, Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- .8 ASTM D6927, Standard Test Method for Marshall Stability and Flow of Asphalt Mixtures.
- .9 ASTM D2419, Test method for Sand Equivalent Values of Soils and Fine Aggregate.
- .10 ASTM D2041, Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
- .11 ASTM D2950, Standard Test Method for Density of Bituminous Concrete in place by Nuclear Methods.
- .12 ASTM D3203, Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- .13 ASTM D4469- Standard method for Calculating Percent Asphalt Absorption by the Aggregate in an Asphalt Pavement Mixture.

#### **1.4 SAMPLES**

- .1 Submit samples in accordance with Section 01 33 00 –Submittal Procedures.
- .2 At least 4 weeks prior to commencing work, submit samples of following materials proposed for use:
  - .1 One 4L container of asphalt cement.

#### **1.5 MATERIAL CERTIFICATION**

- .1 At least 4 weeks prior to commencing work, submit viscosity-temperature chart for asphalt cement to be supplied showing kinematic viscosity in mm<sup>2</sup>/s versus temperature range from 105°C to 175°C.
- .2 At least 4 weeks before commencing work, submit refinery's test data and certification that asphalt cement meets requirements of this section which also includes the specific gravity of the asphalt cement.

#### **1.6 SUBMISSION OF MIX DESIGN**

- .1 Samples of aggregate for mix design shall be derived from stockpiles not less than 1000 tonnes of each of fine and course aggregate.

- .2 The Contractor shall submit, in writing, asphalt concrete mix design and trial mix test results to Departmental Representative for review at least 2 weeks prior to commencing work. The mix design shall contain the job mix formula which shall include the following:
  - .1 Type and specific gravity of asphalt cement.
  - .2 Asphalt cement content.
  - .3 Specific gravity and absorption of each aggregate.
  - .4 Percentage of each aggregate.
  - .5 Gradation of job mix formula.
  - .6 Marshall stability and flow, kN.
  - .7 Bulk specific gravity,  $\text{kg/m}^3$ .
  - .8 Maximum theoretical density,  $\text{kg/m}^3$ .
  - .9 Percentage voids in mineral aggregate.
  - .10 Percentage air voids.
  - .11 Percentage voids filled with asphalt.
  - .12 Percentage of absorbed asphalt cement.
  - .13 TSR (AASHTO T283).

## **1.7 MEASUREMENT AND PAYMENT**

- .1 No measurement for payment shall be made for items under this section. Include all costs in the Lump Sum Amount on the Combined Price Form.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Asphalt cement: to AASHTO PP6, PG 58-28 Grade.
- .2 No RAP shall be permitted in Asphalt Mixes.
- .3 The aggregate blends and physical properties shall meet the requirements set forth in the Government of Newfoundland and Labrador – Department of Transportation and Works Highway Design Division – Works Specification Book (Latest Edition) – Division 3 – Pavement, Selected Granular Base Course and Related Materials – Section 330 – Hot Mix Asphaltic Concrete, for surface course and base course. As well as the following requirements:

- .1 Aggregate shall be crushed quarried stone.
- .2 Crushed fragments: at least 100% of particles by mass to have at least 2 freshly fractured faces.
- .3 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .4 Mineral Filler:
  - .1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.
  - .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.
  - .3 Mineral filler to be dry and free flowing when added to aggregate.
- .5 Anti-Stripping Agents:
  - .1 Do not use anti-strip agent without the approval of the Departmental Representative.
  - .2 Approval for the use of a liquid anti-stripping agent will only be granted should the testing (ASHTO T283) yield a long term TSR of the mix with anti-stripping is equal to or greater than 0.80:
    - .1 Requirements for Liquid anti-stripping agent will also be based on past history of aggregates, and visual examination of test specimens.
    - .2 No additional payment shall be made for the use of anti-stripping agent in the mix.

## 2.2 ASPHALT CONCRETE MIX

1. Mix Design
  - .1 Mix design and Job Mix Formula to be provided by Contractor.
  - .2 Asphalt aggregate mixture to adhere to the following:

Sieve Size (mm)	Percent Passing By Dry Weight	
	Surface Course	Base Course
22.0	100	100
19.0	100	90-100
12.5	93-100	75-90

Sieve Size (mm)	Percent Passing By Dry Weight	
	Surface Course	Base Course
9.5	75-92	63-84
4.75	55-75	35-55
2.00	32-55	20-42
0.425	12-25	10-25
0.150	5-12	5-12
0.075	2-5	2-6

.3 Design to mix: by Marshall Method to requirements below and as directed by Departmental Representative:

.1 Compaction blows on each face of test specimens: 75.

.1 Design of Mix: by the Marshall Method to the requirements below and submit to the Departmental Representative for approval:

Property	Surface Course	Base Course
Marshall Stability at 60°, kN, min	8.0	8.0
Marshall Flow Value, mm	2.5-4.25	2.5-4.25
Air Voids, %	2.5-4.0	2.5-4.0
Voids in Mineral Aggregate, %, min	15	14
Stripping Test, % min	80	80

.2 Asphalt cement content shall be determined by mix design.

.3 The Contractor shall use professional engineering services and a qualified testing laboratory to assess the aggregate materials, asphalt binders, blending sands, mineral fillers, anti-stripping agents and asphalt cement rejuvenation agents proposed for use and to carry out the design of the asphalt concrete mix.

.4 Measure physical requirements as follows:

.1 Marshall stability and flow value: to ASTM D6927.

- .2 Compute void properties on basis of bulk specific gravity of aggregate (to ASTM D2041 and ASTM D4469). Make allowance for volume of asphalt cement absorbed into pores of aggregate.
- .3 Air voids: to ASTM D3203.
- .4 Stripping: to AASHTO T283.
- .5 Do not change job-mix without prior approval of Departmental Representative. Should change in material be proposed, submit new to Departmental representative for approval.
- .6 Return plant dust collected during processing to mix in quantities acceptable to Departmental Representative.

## **2.1 PLANT AND MIXING REQUIREMENTS**

- .1 Feeder lines for loading asphalt cement to the asphalt tanks shall be elevated and drained and the use of diesel fuel to clean asphalt cement pump feeder lines is not permitted. When necessary to use diesel to flush lines and pump, all flushed material shall be collected and not permitted to enter asphalt cement tanks or dumped on the ground.
- .2 Batch and continuous mixing plants:
  - .1 Heat asphalt cement and aggregates to mixing temperatures specified as per the approved mix design. Do not heat asphalt cement above 164°C.
  - .2 Before mixing, dry aggregates to a moisture content not greater than 0.5% by mass or to a lesser moisture content if required to meet mix design requirements.
- .3 Based on current asphalt cement viscosity and specific gravity data measured at the plant, the required temperature of completed asphalt at the plant and at the paver is to be determined based on the consideration of current hauling and placing conditions.
- .4 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders. Aggregate will not be fed directly to the plant from the crusher.
- .5 Feed cold aggregates to plant in proportions that will ensure continuous operations.
- .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
- .7 Store hot screened aggregates in a manner to minimize segregation and temperature loss.
- .8 Maintain temperature of materials within plus or minus 5°C of specified mix temperature during mixing.
- .9 Mixing Time:

- .1 In batch plants, wet mixing shall continue as long as necessary to obtain a thoroughly blended asphalt concrete but not less than 30 s or more than 75 s.
- .2 In continuous mixing plants, mixing time shall be not less than 45 s.
- .3 Do not alter mixing time unless directed by Departmental Representatives.
- .4 **Dryer Drum Mixing Plant:**
  - .1 Feed aggregates to burner end of dryer drum by means of a multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
  - .2 Meter total flow of aggregate by an electronic weigh belt system with an indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate and asphalt cement entering mixer remain constant.
  - .3 Provide for easy calibration of weighing systems for aggregates without having material enter drum.
  - .4 Make provisions for conveniently sampling the full flow of aggregate from the cold feed.
  - .5 Provide screens or other suitable devices to reject oversize particles or lumps of aggregates from cold feed prior to entering drum.
  - .6 Provide a system interlock which will stop all feed components if either asphalt or aggregate from any bin stops flowing.
  - .7 Accomplish heating and mixing of asphalt concrete in an approved parallel flow dryer-mixer in which aggregate and asphalt cement enter drum at burner end and travel parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt cement. Equip systems with automatic burner controls and provide for continuous temperature sensing of asphalt concrete at discharge, with a printing recorder that can be monitored by plant operator. Submit printer record of mix temperatures at end of each week.
  - .8 Mixing period and temperature to produce a uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves plant to be less than 0.5%.
- .5 **Temporary Storage of Hot Asphalt Concrete:**
  - .1 Provide storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
  - .2 Do not keep in storage bins in excess of 3 h.

- .3 While producing asphalt concrete for this project, do not produce it for other users unless separate storage and pumping facilities are provided for materials supplied to this project.
- .6 Mixing Tolerances:
  - .1 Gradations to conform to Section 3.1.
  - .2 Permissible variation of asphalt cement from Job Mix Formula:
    - .1 0.40% (Base Course).
    - .2 0.30% (Surface Course).
  - .3 Permissible variation of asphalt concrete temperature at discharge from plant, 5°C.

### **Part 3 Execution**

#### **3.1 EQUIPMENT**

- .1 General: All equipment used on this project shall be in top operating condition because the project is located on a roadway with very steep grades and sharp curves.
- .2 Pavers: Mechanical grade controlled self-powered pavers capable of spreading asphalt concrete within specified tolerances, true to line, grade and crown indicated:
  - .1 Pavers to be equipped with automatic screed controls, as recommended by manufacturer for control on longitudinal grade and transverse slope.
  - .2 Pavers to be equipped with joint matching shoe to operate with longitudinal grade control.
  - .3 Transverse slope control shall be capable of operating from either side of paver.
- .3 Rollers: Sufficient number of rollers of type and mass to obtain specified density of compacted mix:
  - .1 Vibrator rollers:
    - .1 Minimum drum diameter: 1200 mm.
- .4 Haul Trucks: of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
  - .1 Boxes with tight metal bottoms.
  - .2 Covers (tarps) of sufficient size and weight to completely cover and protect asphalt concrete when truck fully loaded.

- .3 In cool weather for long hauls, insulate entire contact area of each truck box.
- .4 Truck tailgate assemblies must be such that they do not strike paver hoppers when emptying into the hopper.
- .5 Hand Tools:
  - .1 Lutes or rakes with covered teeth for spreading and finishing operations.
  - .2 Tamping irons having mass not less than 12 kg and a bearing area not exceeding 310 cm<sup>2</sup> for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Departmental Representative, may be used instead of tamping irons.
  - .3 Straight edges, 3 m in length, to test finished surface.

### **3.2 PREPARATION**

- .1 Verify all grades prior to paving.

### **3.3 TRANSPORTATION OF ASPHALT CONCRETE**

- .1 Transport asphalt concrete to job site in vehicles clean of foreign material.
- .2 Paint or spray truck beds with limewater, soap or detergent solution, at least once a day or as required. Elevate truck bed and thoroughly drain. No excess solution will be permitted. Diesel fuel is not permitted.
- .3 Schedule delivery of asphalt concrete for placing in daylight, unless Departmental Representative approves artificial lighting.
- .4 Deliver asphalt concrete to paver at a uniform rate and in an amount within capacity of paving and compacting equipment.
- .5 Deliver loads continuously in covered vehicles and immediately spread and compact.
- .6 Deliver and place asphalt concrete at temperature within range as directed by Departmental Representative but not less than 135°C.
- .7 Tarpaulins or other coverings for trucks must be of sufficient mass to prevent rapid cooling of asphalt concrete surface.

### **3.4 PLACING**

- .1 Obtain Departmental Representative's approval of base and existing surface and tack coat prior to placing asphalt.
- .2 Place asphalt concrete to thickness, grades and lines as indicated or as directed by Departmental Representative.
- .3 Placing Conditions:



- .1 Place asphalt concrete only when air temperature is above 5°C and rising.
- .2 When temperature of surface on which asphalt concrete is to be placed falls below 10°C, provide extra rollers as necessary to obtain required compaction before cooling.
- .3 Do not place asphalt concrete when pools of standing water exist on surface to be paved, or during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as indicated on drawings.
- .5 Spread and strike off asphalt concrete overlay with self-propelled mechanical finisher.
- .6 Place individual mats so that the days paving leaves minimal exposed longitudinal cold joint (<10m).
- .7 Construct longitudinal joints and edges true to design.
- .8 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
- .9 Correct irregularities in alignment left by paver by trimming directly behind machine.
- .10 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess asphalt concrete forming high points. Fill and smooth dips with asphalt concrete.
- .11 Do not broadcast asphalt concrete over surface.
- .12 The forward speed of the paver shall be regulated by capacity of the plant and the rollers but shall not exceed a forward speed of 10m/min.
- .13 When hand spreading is used:
  - .1 Approved wood or steel forms, rigidly supported to ensure correct grade and cross section, may be used. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
  - .2 Distribute material uniformly. Do not broadcast material.
  - .3 During spreading operation, thoroughly loosen and uniformly distribute asphalt concrete by lutes or covered rakes. Reject asphalt concrete that has formed into lumps and does not break down readily.
  - .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
  - .5 Provide heating equipment to keep hand tools free from asphalt. Avoid high temperatures which may burn asphalt concrete. Do not use tools at a higher temperature than temperature of asphalt concrete being placed.

### **3.5 COMPACTING**

- .1 Compact asphalt concrete continuously using established rolling pattern.
- .2 Do not change rolling pattern unless asphalt concrete changes or lift thickness changes. Change rolling pattern only as directed by Departmental Representative.
- .3 General:
  - .1 Provide at least three rollers or as many additional rollers as necessary to achieve specified pavement density.
  - .2 Start rolling operations as soon as asphalt concrete can bear mass of roller without undue displacement of asphalt concrete or cracking of surface.
  - .3 Operate roller slowly initially to avoid displacement of asphalt concrete. For subsequent rolling do not exceed 5 km/h for static steel – wheeled rollers and 8km/h for pneumatic – tired rollers.
  - .4 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per meter of travel.
  - .5 Overlap successive passes of roller by at least one half width of roller and vary pass lengths.
  - .6 Keep wheels of roller slightly moistened with water to prevent pick-up of asphalt concrete but do not over-water and do not use diesel fuel.
  - .7 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
  - .8 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
  - .9 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.
  - .10 Where rolling causes displacement of asphalt concrete, loosen affected areas at once with lutes or shovels and restore to original grade of loose asphalt concrete before re-rolling.
  - .11 Do not refuel rollers on fresh asphalt concrete.
- .4 Breakdown Rolling:
  - .1 Commence breakdown rolling with static steel wheeled roller vibratory roller immediately following rolling of transverse and longitudinal joint and edges.
  - .2 Operate rollers as close to paver as necessary to obtain the specified density without causing undue displacement.

- .3 Operate breakdown roller with drive roll or wheel nearest finishing machine. Exceptions may be made when working on steep slopes or super-elevated sections.
- .4 Use only experienced roller operators for this work.
- .5 Second Rolling:
  - .1 Use pneumatic-tired, steel wheel or vibratory rollers and follow breakdown rolling as closely as possible and while paving asphalt concrete temperatures allows maximum density from this operation.
  - .2 Rolling shall be continuous after initial rolling until asphalt concrete placed has been thoroughly compacted.
- .6 Finish Rolling:
  - .1 Use static finish roller to remove roller marks and achieve smooth driving surface.
- .7 All asphalt concrete shall be compacted to 93% of Theoretical Maximum Relative Density (TMRD) in accordance with ASTM D3203.
- .8 The Contractor will supply additional compaction equipment if required density is not achieved.
- .9 Gutters will be compacted with vibratory compactors which operate perpendicular to the direction of the gutter.

### **3.6 JOINTS**

- .1 General:
  - .1 Trim vertical face to provide true surface and cross section against which new pavement may be laid. Remove loose particles.
  - .2 Paint joint face with tack coat emulsified asphalt cement prior to placing of fresh asphalt concrete.
  - .3 Overlap previously laid strip with spreader by 100 mm.
  - .4 Rake fresh asphalt concrete against joint and thoroughly tamp and roll.
  - .5 Remove surplus material from surface of previously laid strip. Dispose of surplus material as directed by Departmental Representative.
  - .6 Do not throw surplus material on freshly screened mat surface.
- .2 Transverse Joints:

- .1 Carefully construct and thoroughly compact transverse joints to provide a smooth riding surface.
- .2 Hold transverse joints to a minimum. When paving single width and maintaining traffic, construct one lane no farther than one-half total paving day.
- .3 Stagger joint locations 1.5 to 3.0 m. Schedule each day's paving operation to terminate adjacent lanes in any one area to within above specified joint locations.
- .4 Offset transverse joint in succeeding course by at least 600 mm.
- .3 Longitudinal Joints:
  - .1 Before rolling, carefully remove with a lute or rake and discard coarse aggregate in asphalt concrete overlapping joint.
  - .2 Roll longitudinal joints directly behind paving operation.
  - .3 When rolling with static roller, shift roller cover onto previously placed lane in order that no more than 150 mm of roll rides on edge of newly laid lane, then operate roller to pinch and press fines gradually across joint. Continue rolling until a thoroughly compacted neat joint is obtained.
  - .4 When rolling with vibratory roller, have most of drum width ride on newly placed lane with remaining 100 to 150 mm extending onto previously placed and compacted lane.
  - .5 When abutting lane is not placed in same day, or when joint is distorted during day's work by traffic or other means, carefully trim edge of lane to line and paint with a thin coating of asphalt before abutting lane is placed.
  - .6 Ensure joints are offset at least 150 to 200 mm from those in lower layers.

### **3.7 FINISH TOLERANCES**

- .1 Finished asphalt concrete to be within 6 mm of design elevation but not uniformly high or low.
- .2 Finished asphalt concrete not to have irregularities exceeding 6 mm when checked with a 3 m straight edge placed in any direction.

### **3.8 TEMPORARY MARKINGS**

- .1 The Contractor shall place temporary pavement markings before sunset following each day's work. Marking material, spacing and type shall be approved by the Departmental Representative.

### **3.9 DEFECTIVE WORK**

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after

final compaction, remove surface course promptly and lay new material to form a true and even surface and compact immediately to specified density.

- .2 Repair areas showing checking or rippling. Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C117, Standard Test Method for Materials Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D260, Standard Specification for Boiled Linseed Oil.
  - .4 ASTM D698-00ae1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>3</sup>) (600 kN-m/m<sup>3</sup>).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-3.3, Kerosene, Amend. No. 1, National Standard of Canada.
  - .2 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
- .3 Canadian Standards Association (CSA International)
- .4 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

**1.2 MEASUREMENT AND PAYMENT**

- .1 No measurement for payment shall be made for items under this section. Include all costs in the Lump Sum Amount on the Combined Price Form.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Concrete mixes and materials: to Section 03 30 00 - Cast-in-Place Concrete.
- .2 Reinforcing steel: to Section 03 20 00 - Concrete Reinforcing.
- .3 Joint filler to Section 03 30 00 - Cast-in-Place Concrete.
- .4 Granular base: to Section 32 11 16.01 – Granular Sub-Base.
  - .1 Class “B” Granular.
- .5 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.
- .6 Fill material: to Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .7 Boiled linseed oil: to ASTM D260.

- .8 Kerosene: to CAN/CGSB-3.3.

### **Part 3 Execution**

#### **3.1 GRADE PREPARATION**

- .1 Excavate to lines, depths and widths indicated or directed.
- .2 Construct embankments using excavated material free from organic matter or other objectionable materials. Provide for minimum 0.5 m shoulders, where applicable, outside of neat lines of concrete.
- .3 Provide borrow material for fill when a deficiency of excavated material exists. Place fill in 150 mm layers and compact to at least 100% of maximum density ASTM D698-12, Method D.

#### **3.2 GRANULAR SUB BASE**

- .1 Obtain Departmental Representative approval of subgrade before placing granular base.
- .2 Place granular base material to lines, widths, and depths as indicated or directed. Compact granular sub base to at least 100% of maximum dry density to ASTM D698-12 Method D.

#### **3.3 CONCRETE**

- .1 Obtain Departmental Representative approval of granular base prior to placing concrete.
- .2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete and as specified herein.
- .3 Round edges, including edges of joints, with 10 mm radius edging tool. Finish surfaces to within 3 mm in 3 m from line, level or grade as measured with a straightedge placed on surface. Finish exposed surfaces to a smooth uniform finish, free of open texturing and exposed aggregate. Do not work more mortar to surface than required. Do not use neat cement as a drier to facilitate finishing. Broom finish surface to provide non-skid texture.
- .4 Cure and protect concrete in accordance with CSA A23.1-14/A23.2-14. Alternatively, apply curing compound to finished surface within one hour of placing at a rate recommended by manufacturer.
- .5 If corrosion protection for de-icing salts is specified use water cure method.

#### **3.4 FORMING**

- .1 Form vertical surfaces to full depth using forming material that will not deform under loading by plastic concrete. Securely position forms to required lines and grades. Coat forms with form release agent.

- .2 Obtain approval of forms before placing concrete.
- .3 Install transitions from full curb to drop curb, 450 mm long where indicated or directed.
- .4 Slip forming may be approved subject to evaluation of mechanical equipment proposed for use. For evaluation by Departmental Representative place 50 metre trial section for Departmental Representative's approval.

### **3.5 EXPANSION AND CONTRACTION JOINTS**

- .1 Install joints in concrete walk as indicated or directed at intervals of:
  - .1 Expansion joints, a maximum of 6 m or in accordance with subsection 3.5.3 of this specification.
  - .2 Transverse contraction joints at approximately the width of the sidewalk but not more than 1.5 times sidewalk width or 3 metres (30 times slab thickness).
- .2 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide. When concrete curb and gutter is constructed adjacent to concrete pavement, the contraction joint spacing of the curb and gutter shall coincide with that of the concrete pavement. When concrete curb and gutter is constructed adjacent to asphalt pavement, transverse joints shall have a uniform spacing not exceeding 4.5 m.
- .3 Install expansion (isolation) joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure, and also before and after curve sections and at intersections of sidewalk and/or curb, to full depth of concrete. Seal joints with approved sealant.
- .4 Install transverse contraction joints 25 mm deep either by oiled steel separators which are removed after concrete has set sufficiently or by sawing the set concrete.
- .5 Combined curb and sidewalk to be provided with a continuous dummy joint 150 mm from the face of the curb. This joint to be similar to the transverse contraction joint and to be 25 mm deep.
- .6 Contraction joint spacing shall vary to coincide with the centreline of manholes, hydrants, poles or other box outs.

### **3.6 BACKFILL**

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material, compact and shape to required contours as indicated or as directed by the Departmental Representative.

### **3.7 CORROSION PREVENTION**

- .1 Apply when specified or directed by the Departmental Representative for protection against de-icing salts. Apply with spray method only, two coats of one to one mixture of boiled linseed oil and kerosene.



- .2 Ensure concrete surfaces are dry, free of dirt or dust, and at least two weeks old before applying coating. Apply each coat at a rate of 0.1 litres per square metre.
- .3 Dry first coat thoroughly before further application.
- .4 Protect adjacent surfaces from spray.

**END OF SECTION**

**Part 1            General**

**1.1                QUALITY ASSURANCE**

- .1      Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2      Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3      Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

**1.2                SOURCE QUALITY CONTROL**

- .1      Advise Departmental Representative of sources of topsoil to be utilized seven (7) working days in advance of stating time.
- .2      Contractor is responsible for soil analysis and requirements for amendments to supply topsoil as specified.
- .3      Soil testing by recognized testing facility for PH, P and K, and organic matter.

**1.3                MEASUREMENT FOR PAYMENT**

- .1      No measurement for payment shall be made for items under this section. Include all costs in the Lump Sum Amount on the Combined Price Form.

**Part 2            Products**

**2.1                TOPSOIL**

- .1      Topsoil for seeded areas: mixture of mineral particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
  - .1      Soil texture based on The Canadian System of Soil Classification, to consist of 20% to 70% sand, minimum 7% clay, and contain 2 to 10 % organic matter by weight.
  - .2      Contain no toxic elements or growth inhibiting materials.
  - .3      Free from:
    - .1      Debris and stones over 50 mm diameter.
    - .2      Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
  - .4      Consistence: friable when moist.

## **2.2 SOIL AMENDMENTS**

- .1 Fertilizer:
  - .1 Fertility: major soil nutrients present in following amounts:
  - .2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
  - .3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
  - .4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
  - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
  - .6 Ph value: 6.5 to 8.0.
- .2 Peatmoss:
  - .1 Derived from partially decomposed species of Sphagnum Mosses.
  - .2 Elastic and homogeneous, brown in colour.
  - .3 Free of wood and deleterious material which could prohibit growth.
  - .4 Shredded particle minimum size: 5 mm.
- .3 Sand: washed coarse silica sand, medium to coarse textured.
- .4 Limestone:
  - .1 Ground agricultural limestone.
  - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .5 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

## **Part 3 EXECUTION**

### **3.1 STRIPPING OF TOPSOIL**

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
- .2 Commence topsoil stripping of areas as indicated after area has been cleared of brush weeds and grasses and removed from site.
- .3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application.
- .4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m.
- .5 Disposal of unused topsoil as directed by Departmental Representative.
- .6 Protect stockpiles from contamination and compaction.

### **3.2 PREPARATION OF EXISTING GRADE**

- .1 Verify that grades are correct. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75 mm above surface. Dispose of removed material off site.
- .4 Course cultivate entire area which is to receive topsoil to minimum depth of 100 mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

### **3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL**

- .1 Place topsoil after Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm, over unfrozen subgrade free of standing water.
- .3 For sodded areas keep topsoil 50/100 mm below finished grade.
- .4 Spread topsoil as indicated to following minimum depths after settlement and 80% compaction:
  - .1 150 mm for seeded areas.
  - .2 135 mm for sodded areas.
  - .3 300 mm for flower beds.
  - .4 500 mm for shrub beds.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

### **3.4 FINISH GRADING**

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Departmental Representative. Leave surfaces smooth, uniform and firm against deep footprinting.

### **3.5 ACCEPTANCE**

- .1 Departmental Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading. Approval of topsoil material subject to soil testing and analysis.
- .2 Testing of topsoil will be carried out by testing laboratory designated by Departmental Representative. Soil sampling, testing and analysis to be in accordance with Provincial

regulations and standards. Departmental Representative will pay for cost of tests as specified in Section 01 40 00 – Quality Requirements.

**3.6 RESTORATION OF STOCKPILE SITES**

- .1 Restore stockpile sites acceptable to Departmental Representative.

**3.7 SURPLUS MATERIAL**

- .1 Dispose of materials not required where directed by Departmental Representative.

**3.8 CLEANING**

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED REQUIREMENTS**

- .1      Section 32 91 19.13 - Topsoil Placement and Grading.

**1.2**            **ADMINISTRATIVE REQUIREMENTS**

- .1      Scheduling:
  - .1      Schedule sod laying to coincide with preparation of soil surface.
  - .2      Schedule sod installation when frost is not present in ground.
  - .3      Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, 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 sod and fertilizer and include product characteristics, performance criteria, physical size, finish and limitations.
- .3      Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements of seed mix, seed purity, and sod quality.
- .4      Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties of seed mix, seed purity, and sod quality.

**1.4**            **DELIVERY, STORAGE AND HANDLING**

- .1      Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2      Storage and Handling Requirements:
  - .1      Store materials in accordance with supplier's recommendations.
  - .2      Replace defective or damaged materials with new.

**PART 2**      **PRODUCTS**

**2.1**            **MATERIALS**

- .1      Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.
  - .1      Turf Grass Nursery Sod types:

- .1 Number One Kentucky Bluegrass Sod: Nursery Sod grown solely from seed of cultivars of Kentucky Bluegrass, containing not less than 50% Kentucky Bluegrass cultivars.  
OR
- .2 Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 40% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivars.
- .2 Turf Grass Nursery Sod quality:
  - .1 Not more than 1 broadleaf weed and up to 1% native grasses per 40 square metres.
  - .2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
  - .3 Mowing height limit: 35 to 65 mm.
  - .4 Soil portion of sod: 6 to 15 mm in thickness.
- .2 Sod establishment support:
  - .1 Wooden pegs: 17 x 17 x 150 mm.
- .3 Water:
  - .1 Supplied by Contractor.
- .4 Fertilizer:
  - .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
  - .2 Complete, synthetic, slow release with 35% of nitrogen content in water-soluble form.

## **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 sod 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**      **PREPARATION**

- .1 Verify that grades are correct and prepared in accordance with Section 32 91 19.13 - Topsoil Placement and Grading. If discrepancies occur, notify Departmental Representative and commence work when instructed by Departmental Representative.

- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade surface free of humps and hollows to smooth, even grade, elevations indicated, to tolerance of plus or minus 8 mm, surface to drain naturally.
- .4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.

### **3.3 SOD PLACEMENT**

- .1 Ensure sod placement is done under supervision of certified Landscape Planting Supervisor.
- .2 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.
- .3 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .4 Roll sod as directed by Departmental Representative. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

### **3.4 SOD PLACEMENT ON SLOPES AND PEGGING**

- .1 Install and secure geotextile fabric in areas indicated, in accordance with manufacturer's instructions.
- .2 Start laying sod at bottom of slopes.
- .3 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1 m of catch basins and within 1 m of drainage channels and ditches to following pattern:
  - .1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.
  - .2 Not less than 3-6 pegs per square metre.
  - .3 Not less than 6-9 pegs per square metre in drainage structures. Adjust pattern as directed by Departmental Representative.
  - .4 Drive pegs to 20 mm above soil surface of sod sections.

### **3.5 FERTILIZING PROGRAM**

- .1 Fertilize during establishment and warranty periods as recommended by sod supplier.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 13 - Progress Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 23 - Final Cleaning.
  - .1 Clean and reinstate areas affected by Work.



**3.7 MAINTENANCE DURING ESTABLISHMENT PERIOD**

- .1 Perform following operations from time of installation until acceptance.
  - .1 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.
  - .2 Cut grass to 50 mm when or prior to it reaching height of 75 mm.
  - .3 Maintain sodded areas 95% weed free.
  - .4 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.

**3.8 ACCEPTANCE**

- .1 Turf Grass Nursery Sod areas will be accepted by Departmental Representative provided that:
  - .1 Sodded areas are properly established.
  - .2 Sod is free of bare and dead spots.
  - .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.
  - .4 Sodded areas have been cut minimum 2 times prior to acceptance.
- .2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.
- .3 When environmental conditions allow, all sodded areas showing shrinkage cracks shall be top-dressed and seeded with a seed mix matching the original.
- .4 Continue maintenance and mowing until acceptance.

**3.9 MAINTENANCE DURING WARRANTY PERIOD**

- .1 Perform following operations from time of acceptance until end of warranty period:
  - .1 Water sodded areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.
  - .2 Repair and re-sod dead or bare spots.
  - .3 Cut grass and remove clippings that will smother grass to height as follows:
    - .1 Turf Grass Nursery Sod:
      - .1 50 mm during normal growing conditions.
    - .2 Cut grass so that approximately one third of growth is removed in single cut.
    - .3 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.
    - .4 Eliminate weeds by mechanical means.

**END OF SECTION**



## **APPENDIX A**

### **POST-FIRE BUILDING CONDITION ASSESSMENT**



**ARCHITECTURAL/STRUCTURAL  
POST-FIRE BUILDING CONDITIONASSESSMENT  
BAY d'ESPOIR RCMP DETACHMENT**



Prepared for: Mr. Don Currie  
Manager, Real Property  
RCMP "B" Division

Prepared by: Gibbons Snow Architects Inc.



**March 8, 2017**

## **1.0 Background**

The Bay d'Espoir RCMP Detachment building was damaged by fire on January 17, 2017. Since the fire, the Building has been remediated and smoke and fire damaged materials have been removed by Belfor. The building is currently unoccupied.

## **2.0 Introduction**

Gibbons Snow Architects Ltd. (GSA) along with Crosbie Engineering Ltd. (CE), were recently commissioned to conduct a post-fire assessment of the Bay d'Espoir Detachment building. The intent of the assessment is to determine the current structural and building envelope integrity along with commentary on the remaining mechanical systems condition. On March 1, 2017 Greg Snow of GSA and Dean Hopkins of CE conducted an on-site assessment of the building. Pat Pike of RCMP was in attendance as well.

## **3.0 Architectural Assessment**

### **3.1 Building General Description**

The building is a combination of wood frame and concrete/concrete masonry unit (CMU) construction. All floors are slab-on-grade. The office portion of the is wood frame exterior walls and the cell block area is CMU with a suspended concrete slab above. The roof consists of wood trusses and wood sheathing and asphalt shingles. The exterior walls are clad with brick and metal siding and windows are aluminum.

### **3.2 As-found Condition**

Since the building has been remediated by Belfor, currently all interior furniture, partitions and finishes have been removed from the office area. Also, all the interior gypsum board, vapour barrier and insulation has been removed, basically leaving the building structural shell and exterior finishes and windows.

### **3.3 Structural Systems**

The wood structure of the exterior walls and roof are undamaged and their structural integrity has not been compromised. There was some smoke discolouration on the interior of the roof sheathing that has been sealed with paint by Belfor, however this has not affected ant structural integrity. The cell block walls and ceiling/roof are undamaged and retain their structural integrity.

### **3.4 Building Envelope**

The remaining exterior building envelope including exterior wall cladding and sheathing and roof sheathing and membranes are all in very good condition, with no damage, except for the window glazing. The window glazing has been heat damaged and is cracked in many locations.

### 3.5 Conclusions and Recommendations

This building is structurally sound and the remaining building envelope is in very good condition and therefore suitable for re-use and fit-up improvements without any modifications to the existing construction. The only exception is the window glazing and gasketing, which will need to be replaced. At the time of glazing replacement, the window frames should be more closely inspected to ensure not other problems are present within the interior of the window framing assemblies.

Assessor:



---

Greg Snow, MRAIC, NLAA  
Gibbons Snow Architects Inc.

**APPENDIX "A"**

**SITE PHOTOS**





**1 – Interior - View Towards Cell Block Area**



**2 – Interior - View of Exterior Wall**



**3 –View of Roof Structure**



**4–View of Floor Slab in Office Area**





**5 - View Above Cell Block**



**6 - Interior - View of Window**



## **Mechanical/Electrical Assessment Bay d'Espoir Detachment**



**Submitted to:**

**Mr. Greg Snow, NLAA, MRAIC, Architect**  
**Gibbons Snow Architects Inc.**  
Suite 201 Caledonia Place  
40 Quidi Vidi Road  
St. John's, NL A1A 1C1

**Submitted by:**



CEL Project No.: 17-2234

March 7, 2017



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## INTRODUCTION

Crosbie Engineering Ltd. has been requested by Gibbons Snow Architects Inc. to conduct a mechanical and electrical assessment of the existing Bay d'Espoir RCMP Detachment. The Detachment recently had a fire that destroyed the interior of Office section of the building. The cell block was not affected with the exception of some smoke damage.

On Wednesday, March 1, 2017 Dean Hopkins, CET of Crosbie Engineering Limited visited the site and completed a building evaluation assessment. Photos of the site visit are included in Appendix A.

## OBSERVATIONS

### 2.0 MECHANICAL INSPECTION

There is limited mechanical equipment and systems remaining in the detachment after the fire and abatement demolition had been concluded. The photos that follow show some of the remaining elements that are further described below.

There appears to be an exterior louvre and a very small section of the interior ductwork remaining that had been previously associated with a mechanical ventilation system. The louvre appears to be old and the paint peeling in places, we would recommend it be replaced as part of new HVAC work.

There are a few ceiling mounted security grilles still in place that are in fair condition. Unless the secure rooms they are located in remain unchanged we would recommend these be replaced as part of new HVAC work.

There is an existing domestic hot water tank still located inside the building on the floor. This tank appears to be in fair condition, we would recommend it be replaced as part of new plumbing work.

The under-slab plumbing piping is likely all reusable to the degree future renovations match up to the locations of the piping and floor stub ups.

There is an existing water entry pipe, cut off approximately 2m above the floor that appears to have little or no damage. Based on the age of the building we would recommend a new shut off valve be installed on

this pipe just inside the building. To do this work the curbstop outside the building would need to be operable and shut off to this work.

There is piping clevis hangers located in several rooms with piping having been demolished. These hangers should be removed and discarded as part of new work in the detachment.

Overall there are very few mechanical elements remaining in the building that will contribute to the future operation of the detachment.

### **3.0 ELECTRICAL INSPECTION**

Electrical power is supplied to the building via an underground electrical service rated 400 amps, 120/240 Volts, single phase, 3 wire. The service conductors run down the service pole in RGS conduit and then underground to a 400 amp service entrance rated main fused disconnect switch located in the main building electrical room. From the disconnect switch it runs to a CT cabinet and on to a 400 amp splitter trough. There are two combination panelboards located above the splitter through.

All the distribution equipment is original to the building and not in very good condition. Most all the branch circuit wiring from the panelboards have been recently removed by the fire abatement contractor. Only two existing walls of the electrical room remain, the others have been removed.

The complete interior of the office section of the building have been demolition including all walls, ceilings, flooring, etc. As well all electrical equipment including lighting, exit and emergency lighting, wiring devices, fire alarm, security system, heating, voice/data system, etc. have been removed.

It is recommended that a new electrical service entrance including conduit and wiring be installed for the new interior fit-up. All new panelboards are to be installed with new branch circuit wiring.

A complete new electrical fit-up is required.

**APPENDIX "A"**  
**SITE PHOTOS**







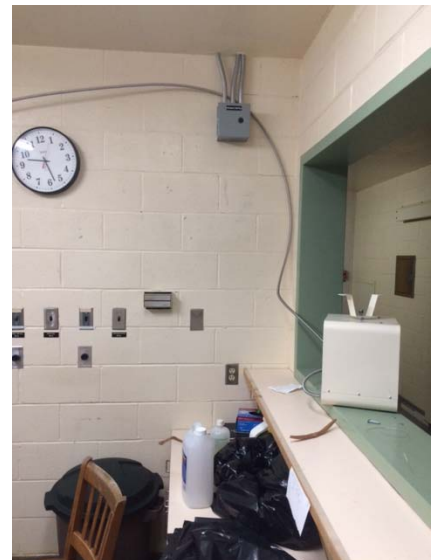
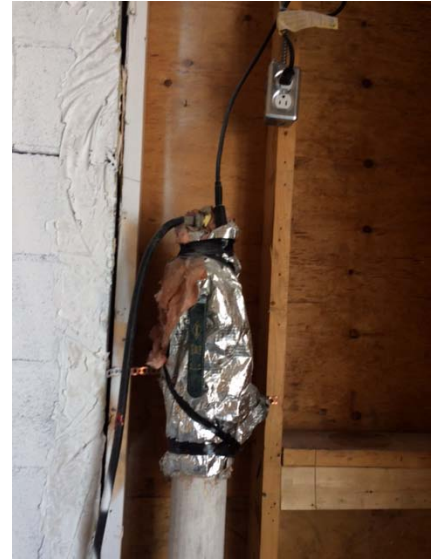


















## **APPENDIX B**

CEAA 2010 - ENVIRONMENTAL EFFECTS DETERMINATION



CEAA 2012 – Environmental Effects Determination

Project Location: 390 Forest Rd, Bay d'Espoir, NL	Project Name: Detachment Refurbishment- Bay d'Espoir, NL	Project Number: 1005744
Project Manager: Tony Simpson	Email: tony.simpson@rcmp-grc.gc.ca	Phone Number: 506-451-6092

1. Complete the following table in order to identify the relevant potential adverse environmental effects.

Project Phase	Component / Activity	Environmental Effects							Socio-Economic Effects (aboriginal peoples)				Socio-Economic Effects (general – non-aboriginal peoples)				
		1 - Harmfully alter, disturb or destroy vulnerable natural features (e.g. habitat for endangered species, water source for a town, wetlands, etc.)?	2 - Release a polluting substance into the land, water, or air?	3 - Cause land use changes (e.g. resource extraction, deforestation, clearing of vegetation, etc.)?	4 - Affect vegetation, birds and wildlife (flora and fauna), including species at risk and its critical habitat?	5 - Result in alteration of water level, quality, flow or management regime in a water body, or result in other important changes to surface or groundwater resources (including well-water)?	6 - Cause sensory disturbances (i.e. eyesores, noise, vibrations, smells)?	7 - Cause any other change to the environment on federal lands or incidental to a federal decision? If so, define:	8 - Health and Socio-economic conditions (e.g. impact to an aboriginal fishery resulting from a change in fish population).	9 - Physical and cultural heritage.	10 - The current use of lands and resources for traditional purposes (e.g. hunting and gathering).	11 - Any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.	12 - Other? Please specify.	13 - Health and Socio-economic conditions (e.g. impact to a commercial fishery resulting from a change in fish population).	14 - Physical and cultural heritage.	15 - Any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.	16 - Other? Please specify.
Mobilization	1. Transport equipment and materials to site	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.
Site Preparation and Construction	2. Site Preparation	.	\$	\$	.	.	.	.	.	.	.	.	.	.	.	.	.
	3. Construction – Detachment Refurbishment	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.
	4. Construction – Storage Building	.		.	.	.	.	\$	\$	.	.	.	.	.	.	.	.
	5. Installation of HVAC equipment	.	\$	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	6. Construction – Walkways	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.
	7. Landscaping	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Demobilization	8. Transport equipment and materials from site	.		.	.	.	.	.	.	.	.	.	.	.	.	.

Legend: '.' = No interaction, '|' = potential interactions are not significant (i.e. negligible, small magnitude and reversible), '\$' = potential significant environmental impact

If the answer is 'S' to at least one question in the above table, proceed to 2.

If the answers to every question in the above table is either '.' and/or '|', proceed to 3.

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2. Identify Mitigation Measures

Complete a new line in the table below for each, Environmental Effect or Socio-Economic Effect for which a potential significant impact was identified in Section 1.

#	Effect	Environmental / Socio Economic Effect	Mitigation Measures Describe the effective and established mitigation measure which will be used to manage corresponding potential adverse biophysical and/or socio-economic effect.**	Mitigation measures effective and established <sup>1</sup> (Y/N)
2,5,6,7	2	Potential accidental release from equipment (ie. fuel, hydraulic fluid, oil, halocarbons, etc.)	<p>Prepare a site specific spill response plan, which includes, but is not limited to, the following:</p> <ul style="list-style-type: none"> <li>-Perform all work related to fuel storage tanks in accordance with the Federal Storage Tank Regulations (2008), Canadian Environmental Protection Act 1999.</li> <li>-Ensure spill contingency equipment and measures in place before work begins</li> <li>-Ensure all equipment is well maintained and free of leaks</li> <li>-Establish appropriate spill reporting procedures.</li> <li>-Report/manage immediately any leaks and spills</li> <li>-Do not conduct fueling activities where run-off could carry contaminants into drainage pathways</li> </ul> <p>-All work in relation to halocarbon containing equipment must be completed in accordance with the Federal Halocarbon Regulations 2003, Canadian Environmental Protection Act, 1999.</p>	Y
2,6,7	2	Dust production from vehicle movement	<p>Prepare an Environmental Protection Plan which includes but not limited to the following:</p> <ul style="list-style-type: none"> <li>-We/cover dry, exposed soils on which there will be vehicle movement or disturbance</li> <li>-Cover stockpile soils with tarps</li> </ul>	Y
2,6,7	2	Decrease in air quality from vehicle emissions	<p>Prepare an Environmental Protection Plan which includes but not limited to the following:</p> <ul style="list-style-type: none"> <li>-Control emissions from equipment to local emission requirements</li> <li>-Ensure all equipment is properly tuned, in good operating condition and fitted with standard air emission control devices</li> <li>-Minimize idling of engines at all times</li> </ul>	Y
2	3	Damage/alteration of site vegetation during land clearing and development	<ul style="list-style-type: none"> <li>-Perform only the minimum amount of land clearing required for the proposed storage building based on structure footprints and location on the subject property.</li> </ul>	Y
2, 6	2,5	Increased runoff/sedimentation resulting from soil disturbance and changes to landscape	<p>Prepare an Environmental Protection Plan that includes measures for sedimentation and erosion control. Measures include but are not limited to:</p> <ul style="list-style-type: none"> <li>-Halt construction activity on exposed soils during high intensity rainfall events</li> <li>-Minimize vegetation cover removal</li> <li>-Control run-off water containing suspended materials or other harmful substances in accordance with local authority requirements, using appropriate methods/equipment such as bales, vegetation filter strips, diversion ditches, settlement ponds, sediment traps, and/or silt fences</li> <li>-Cover stockpiled soils with tarps</li> <li>-Replant disturbed areas as soon as possible</li> </ul>	Y
2	3	Increased erosion potential during construction as a result of	<p>Prepare an Environmental Protection Plan that includes measures for sedimentation and erosion control. Measures include but are not limited to:</p> <ul style="list-style-type: none"> <li>-Cover stockpiled soils with tarps</li> <li>-Replant disturbed areas as soon as possible</li> </ul>	Y

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		site preparation and landscaping	-Protect exposed soils with coarse granular materials, mulches, or straw -Use interceptor ditches or berms up gradient of construction to divert overland flow around exposed soils -Line steep ditches with filter fabric, rock, or polyethylene lining to prevent channel erosion	
2	3	Loss of topsoil due to disturbance and movement during site preparation and landscaping	Prepare an Environmental Protection Plan that includes measures for sedimentation and erosion control. Measures include but are not limited to: -Remove and store topsoil separately and cover with tarp -Strip topsoil when dry enough to prevent contamination with subgrade material -Do not handle topsoil in wet or frozen condition -Replace excavated soils in the same order after completion of work -Replant disturbed areas as soon as possible	Y
2,6,7	3	Compaction due to heavy equipment and vehicle traffic	-Restrict vehicular traffic to construction site and approved access routes -Minimize construction traffic during wet conditions -Restrict parking to designated areas -Cultivate soils before planting	Y
1,2,4,6,7,8	6	Sensory disturbances caused by construction	-Confine work, where practical, to normal working hours -Follow requirements of local governing authorities	Y
3,4	7	Management of construction waste	Prepare a project-specific waste management plan that includes, but is not limited to the following: -Methods will be used to minimize and divert waste both hazardous and non-hazardous waste throughout the project -Construction waste must be recycled or disposed of according to local infrastructure -Hazardous wastes to be stored in sealed, labeled containers and disposed of in accordance with applicable regulations -Keep work area free from accumulation of waste materials and debris	Y

1 - Mitigation measures are considered effective and established if they meet all of the following criteria: have been implemented before in similar situations, are well understood and considered reliable, and are 'Avoid - type' or 'Reduce - type' mitigation measures.

\*\*The mitigation measures identified above reflect effective and established mitigation measures for the environmental interactions identified in Table 1 and shall be reflected in the project specifications and/or in the subsequent environmental protection plans (i.e. spill response, sedimentation and erosion control, waste management, contaminant prevention, excavation and dewatering plan, historical/archaeological/cultural resources, etc.). Alternative equivalent measures may be presented in the Environmental Protection Plans as deemed appropriate by the site professional. All proposed measures must be proven effective and established to mitigate the identified environmental interaction. Environmental Protection Plans will be reviewed and approved by RCMP Environment.

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3. Resources Consulted

List any resources consulted within the completion of this form (e.g. expert departments, external sources, scientific articles, codes of practice, guidelines, standard operation procedures, etc.).

Federal Halocarbon Regulations (2003)

Dillon Consulting Limited. February 29, 2008. Phase I Environmental Site Assessment, RCMP Detachment 390 Head Bay D'Espoir Highway, NL, Public Works and Government Services Canada

4. RCMP Environmental Unit Recommendation, Sign-off and Project Manager Acknowledgment:

Bridget Gillis, Environmental Analyst



2018/09/13

RCMP Divisional Environmental Name

Signature

Date

a.  Project may proceed.

As there are no project/environment interactions, there are no potential adverse biophysical and/or socio economic effects. Therefore, the project is not likely to cause significant adverse environmental effects. No mitigation measures are required.

There are project/environment interactions and mitigation measures have been identified. All the mitigation measures identified in section 2 are determined to be effective and established. Taking into account implementation of mitigation measures outlined in the analysis, this project is not likely to cause significant adverse environmental effects.

b.  Project may not proceed. Requires further analysis. Complete a Non-Basic Project Environmental Effects Determination Form.

As either the answer of "Unknown" was provided in section 1 and / or at least one mitigation measures in section 2 is determined to not be an effective and established mitigation measures.

c. Comments (optional):

Project Manager Acknowledgment: The RCMP Project Manager acknowledges the above determination. If project may proceed, the RCMP Project Manager agrees to include the mitigation measures (outlined in Section 2) in the project contract and ensure the contractor implements all measures accordingly.

Tony Simpson



2018-Sep-13

Project Manager (print)

Signature

Date