

# **Specifications**

## **Ingonish Beach Washroom and Kiosk Facility**

### **VOLUME 2**

**Ingonish Beach  
Cape Breton Highlands  
National Park of Canada  
Nova Scotia**

**Issued for Tender  
2022-03-31**



## **VOLUME 1**

### **DIVISION 00 - BIDDING DOCUMENTS**

*Refer to Public Services and Procurement Canada (PSPC) Documents for Procurement Documents*

00 01 01.01	COVER PAGE – VOLUME 1
00 01 10.01	TABLE OF CONTENTS – VOLUME 1

### **DIVISION 01 - GENERAL REQUIREMENTS**

01 11 00	GENERAL REQUIREMENTS
	- ROLES, RESPONSIBILITIES AND DEFINITIONS
	- SCOPE OF WORK SUMMARY
	- WORK RESTRICTIONS
	- PAYMENT PROCEDURES FOR TESTING
	- PROJECT MEETINGS
	- CONSTRUCTION SCHEDULE
	- SUBMITTAL PROCEDURES
	- HEALTH AND SAFETY
	- REGULATORY REQUIREMENTS
	- QUALITY CONTROL
	- TEMPORARY UTILITIES
	- CONSTRUCTION FACILITIES
	- TEMPORARY BARRIERS AND ENCLOSURES
	- COMMON PRODUCT REQUIREMENTS
	- PRODUCT OPTIONS AND SUBSTITUTIONS
	- EXAMINATION AND PREPARATION
	- EXECUTION
	- CLEANING
	- WASTE MANAGEMENT AND DISPOSAL
	- CLOSEOUT PROCEDURES
	- CLOSEOUT SUBMITTALS
01 34 43	ENVIRONMENTAL PROCEDURES
01 55 26	TRAFFIC CONTROL

### **DIVISION 03 - CONCRETE**

03 35 00	CONCRETE FINISHING
----------	--------------------

### **DIVISION 05 - METALS**

05 50 00	METAL FABRICATIONS
----------	--------------------

### **DIVISION 06 - WOOD, PLASTICS AND COMPOSITES**

06 10 10	ROUGH CARPENTRY
06 20 00	FINISH CARPENTRY
06 40 00	ARCHITECTURAL WOODWORK

### **07 - THERMAL AND MOISTURE PROTECTION**

07 11 10	BITUMINOUS DAMPPROOFING
07 21 13	BOARD INSULATION
07 21 16	BLANKET INSULATION
07 21 19	FOAMED-IN-PLACE INSULATION
07 26 16	UNDER-SLAB VAPOUR RETARDER
07 27 14	AIR AND VAPOUR BARRIERS

07 46 19	STEEL SIDING
07 46 23	WOOD SIDING AND SOFFIT
07 61 00	SHEET METAL ROOFING
07 62 00	SHEET METAL FLASHING AND TRIM
07 84 00	FIRESTOPPING
07 92 00	JOINT SEALANTS

#### **DIVISION 08 - OPENINGS**

08 11 13	METAL DOORS AND FRAMES
08 11 16	ALUMINUM DOORS AND FRAMES
08 31 00	ACCESS DOOR AND PANELS
08 50 13	ALUMINUM WINDOWS
08 80 50	GLAZING
08 87 53.01	GLAZING FILMS

#### **DIVISION 09 - FINISHES**

09 21 16	GYPSUM BOARD ASSEMBLIES
09 30 13	TILING
09 91 00	PAINTING
09 96 53	POWDER COATING

#### **DIVISION 10 - SPECIALTIES**

10 28 10	TOILET AND BATH ACCESSORIES
----------	-----------------------------

#### **DIVISION 31 - EARTHWORK**

31 00 99	COMMON WORK RESULTS FOR EARTHWORKS
31 11 00	CLEARING AND GRUBBING
31 14 13	SOIL STRIPPING AND STOCKPILING
31 22 13	ROUGH GRADING
31 25 00	EROSION AND SEDIMENT CONTROL
	- EROSION AND SEDIMENT CONTROL HANDBOOK
31 32 19.16	GEOTEXTILES
31 36 00	GABIONS

#### **DIVISION 32 - EXTERIOR IMPROVEMENTS**

32 01 90.33	TREE AND SHRUB PRESERVATION
32 11 16.01	GRANULAR SUB-BASE
32 11 23	AGGREGATE BASE COURSES
32 13 15	CONCRETE PAVING, SIDEWALKS, CURBS AND GUTTERS
32 15 40	CRUSHED STONE SURFACING
32 63 40	NATURAL ROCK BOULDERS AND DECORATIVE STONE
32 91 21	TOPSOIL AND FINISH GRADING
32 92 19.16	HYDRAULIC SEEDING
32 93 43.01	TREE PRUNING

## **VOLUME 2**

40 01 01.02	COVER PAGE – VOLUME 2
40 01 10.02	TABLE OF CONTENTS – VOLUME 2

## **DIVISION 21 – FIRE SUPPRESSION**

21 24 16	FIRE EXTINGUISHERS
----------	--------------------

## **DIVISION 22 - PLUMBING**

22 05 00	COMMON WORK RESULTS FOR PLUMBING
22 10 10	PLUMBING PUMPS
22 11 16	DOMESTIC WATER PIPING - COPPER
22 11 17	DOMESTIC WATER PIPING - PLASTIC
22 13 17	DRAINAGE, WASTE AND VENT PIPING – CAST IRON AND COPPER
22 13 18	DRAINAGE, WASTE AND VENT PIPING – PLASTIC
22 30 05	DOMESTIC WATER HEATERS
22 42 01	PLUMBING SPECIALITIES AND ACCESSORIES
22 42 13	PLUMBING FIXTURES AND TRIM

## **DIVISION 23 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC)**

23 05 00	COMMON WORK RESULTS – MECHANICAL
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 05 53	MECHANICAL IDENTIFICATION
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC
23 07 13	THERMAL INSULATION FOR DUCTING
23 07 20	THERMAL INSULATION FOR PIPING
23 09 33	ELECTRONIC CONTROL SYSTEM FOR HVAC
23 31 13.01	METAL DUCTS – LOW PRESSURE
23 32 48	ACOUSTICAL AIR PLENUMS
23 33 00	AIR DUCT ACCESSORIES
23 33 14	DAMPERS – BALANCING
23 33 15	DAMPERS – OPERATING
23 33 16	DAMPERS – FIRE AND SMOKE
23 33 46	FLEXIBLE DUCTS
23 37 13	DIFFUSERS, REGISTERS AND GRILLES
23 37 20	LOUVERS, INTAKES AND VENTS
23 72 00	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

## **DIVISION 26 - ELECTRICAL**

26 05 00	COMMON WORK RESULTS FOR ELECTRICAL
26 05 20	WIRE AND BOX CONNECTORS (0-1000V)
26 05 21	WIRES AND CABLES (0-1000V)
25 05 27	GROUNDING - PRIMARY
25 05 28	GROUNDING - SECONDARY
26 05 29	HANGERS AND SUPPORT OF ELECTRICAL SYSTEMS
26 05 31	SPLITTERS, JUNCTION, PULL BOXES AND FITTINGS
26 05 32	OUTLET BOXES, CONDUIT BOXES AND FITTINGS
26 05 34	CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS
26 05 43.01	INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS
26 09 24	LIGHTING CONTROL DEVICES
26 24 16.01	PANELBOARDS BREAKER TYPE
26 27 26	WIRING DEVICES
26 28 16.02	MOULDED CASE CIRCUIT BREAKERS

26 28 20	GROUND FAULT CIRCUIT INTERRUPTERS
26 50 00	LIGHTING
26 52 00	UNIT EQUIPMENT FOR EMERGENCY LIGHTING

**DIVISION 27    COMMUNICATIONS**

27 05 28	PATHWAYS FOR COMMUNICATIONS SYSTEMS
----------	-------------------------------------

**DIVISION 33    UTILITIES**

33 65 76	DIRECT BURIED UNDERGROUND CABLE DUCT
33 71 73.02	UNDERGROUND ELECTRICAL SERVICE

**DRAWINGS    BOUND SEPARATELY**

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 01 11 00 – General Requirements.
- .2 Section 23 05 53 – Mechanical Identification.

**1.2 REFERENCE STANDARDS**

- .1 National Fire Prevention Association (NFPA):
  - .1 NFPA 10 - Portable Fire Extinguishers, 2013 Edition.
- .2 National Building Code of Canada - 2015, including latest errata.
- .3 National Fire Code of Canada - 2015, including latest errata.
- .4 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC S508-2002 (R2007) - Rating and Fire Testing of Fire Extinguishers and Class "D" Extinguishing Media.
- .5 Authorities Having Jurisdiction:
  - .1 Conform to the requirements of the Authority Having Jurisdiction.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in 01 11 00 – General Requirements.

**PART 2 PRODUCTS**

**2.1 FIRE EXTINGUISHERS**

- .1 FE1: (Finished Space – Surface Mounted)
  - .1 10 lb. (4.54 kg) Type ABC dry chemical (ammonium phosphate powder) extinguisher with surface mounted prime coated 16 ga. steel cabinet. Cabinet color by Departmental Representative.

**2.2 IDENTIFICATION**

- .1 Identify fire extinguisher cabinets in accordance with section 23 05 53 – Mechanical Identification and the recommendations of NFPA 10.
- .2 Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

---

**PART 3        EXECUTION**

**3.1            INSTALLATION**

- .1        Install or mount extinguishers where indicated on drawings on brackets.
- .2        Fire extinguishers to be installed so that maximum travel distance to exit does not exceed 22.86m (75'-0").
- .3        Fire extinguishers to be installed 1524mm (5'-0") max to top of cabinet from finished floor.
- .4        All installation work to be in accordance with the Departmental Representative.
- .5        Protect finished cabinets until turn over to Departmental Representative.

END

**PART 1 GENERAL**

**1.1 GENERAL CONDITIONS**

- .1 Division 01 – General Requirements, Division 21 - Fire Suppression, and Division 23 – Heating, Ventilation and Air Conditioning (HVAC) as applicable; are part of this Section and shall apply as if repeated here.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 22 11 16 – Domestic Water Piping – Copper.
- .3 Section 22 13 17 – Drainage, Waste and Vent Piping – Cast Iron and Copper.
- .4 Section 22 13 18 – Drainage, Waste and Vent Piping – Plastic.
- .5 Section 22 30 05 – Domestic Water Heaters.
- .6 Section 22 42 01 – Plumbing Specialities and Accessories.
- .7 Section 23 05 00 – Common Work Results – Mechanical.
- .8 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .9 Section 23 05 53 – Mechanical Identification.
- .10 Section 23 07 20 – Thermal Insulation for Piping.

**1.3 REFERENCE STANDARDS**

- .1 National Building Code of Canada - 2015, including latest errata.
- .2 National Plumbing Code of Canada - 2015, including latest errata.
- .3 National Fire Code of Canada - 2015, including latest errata.
- .4 Authorities Having Jurisdiction:
  - .1 Conform to the requirements of the Authority Having Jurisdiction.

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements.
- .2 Provide one (1) digital copy in Adobe PDF of shop drawings (ensure Contractor's markups and stamp is embedded prior to submission) for all equipment specified and/or indicated including but not limited to the following items:
  - .1 Fire stopping Materials (by this Contractor);
  - .2 Floor Drains;
  - .3 Piping (All Types);
  - .4 Cleanouts;



- .5 Backflow Preventers;
  - .6 Valves (All Types);
  - .7 Hot Water Tanks (All Types);
  - .8 Pipe Hangers;
  - .9 Water Meters;
  - .10 Mixing Valves;
  - .11 Expansion Tanks;
  - .12 Trap Primers; and
  - .13 Plumbing Fixtures.
- .3 Contractor is to maintain record drawings on site showing significant deviation from the contract documents and shop drawings.

## 1.5 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Manuals: Provide operation and maintenance data for incorporation into the maintenance manual specified in Section 01 11 00 – General Requirements.
- .1 Operation and maintenance manual to be approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .2 Operation data to include:
    - .1 Description of actions to be taken in event of equipment failure.
    - .2 Valves schedule and flow diagram.
    - .3 Colour coding chart.
    - .4 Legend of above ceiling identifiers.
  - .3 Maintenance data shall include:
    - .1 Servicing, maintenance, operation and troubleshooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .4 Performance data to include:
    - .1 Equipment performance verification test results.
    - .2 Special performance data as specified elsewhere.
    - .3 Cross connection and backflow device inspection report for each installed backflow preventer.
  - .5 Additional data:
    - .1 MSDS for all hazardous material installed and left stored on site or with the Departmental Representative.
    - .2 Analysis of hydronic systems water after cleaning and treatment of piping.
  - .6 Provide identification of all valves as required by Section 23 05 53 – Mechanical Identification.
  - .7 Provide updated, approved shop drawings for inclusion in the maintenance manuals.
  - .8 Provide certificate indicating that the installation satisfies:
    - .1 Local Authority Having Jurisdictions requirements.
  - .9 Approvals:
    - .1 Submit one (1) DIGITAL copy of the draft Operation and Maintenance Manual in bookmarked PDF to Departmental Representative for approval.

- Submission of individual data will not be accepted unless so directed by Departmental Representative.
- .2 Make changes as required and resubmit as directed by Departmental Representative.
- .2 As Built/Record Drawings:
- .1 Site Records:
- .1 The Departmental Representative will provide one (1) set of reproducible plumbing drawings. Provide one (1) set of white prints as required for each phase of the work. The contractor shall mark thereon all changes as work progresses and as changes occur.
- .2 On a (weekly) basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
- .3 Make available for reference purposes and inspection at all times.
- .2 As Built/Record Drawings:
- .1 Identify each drawing in lower right hand corner in letters at least ½" high as follows: "AS BUILT/RECORD DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW PLUMBING SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
- .2 Submit to Departmental Representative for approval and make corrections as directed.
- .3 Submit completed reproducible as built/record drawings with each of the Operating and Maintenance Manuals.
- .4 The Departmental Representative shall use the Contractor's marked up drawings to produce electronic copies of the As-Built/Record Drawings, refer also to Section 01 11 00 – General Requirements: Closeout Submittals.
- .3 Warranty: Submit warranties in maintenance manuals as specified in Section 01 11 00 – General Requirements: Closeout Submittals.
- .4 Guarantee:
- .1 Submit manufacturers' written guarantees to the Departmental Representative for review.
- .2 Bind guarantees in hard cover report binder suitable for 8½" x 11" sheets. Label cover "Guarantees" and show project name. Provide title sheet and table of contents.
- .3 Each guarantee shall include:
- .1 Project name and address.
- .2 Guarantee time period (commencement date shall be as date shown on Project Final Certificate of Completion unless otherwise indicated).
- .3 Clear and concise definition of what is guaranteed and remedial action provided.
- .4 Signatures of Plumbing Trade Contractor and a company officer of the manufacturing firm.
- .4 Include all extended guarantees (and service contracts) as specified in individual sections.

**1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 11 00 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

**1.7 EQUIPMENT LIST**

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

**1.8 TRIAL USAGE**

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

**1.9 PROTECTION OF OPENINGS**

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

**1.10 CLEANING**

- .1 To Section 01 11 00 – General Requirements.
- .2 Clean the job site daily. If the site is not cleaned to the Departmental Representative's satisfaction, then the Departmental Representative shall make arrangements for cleaning and charge the cost against the Contract.

**1.11 PAINTING**

- .1 To Section 09 91 00 - Painting.
- .2 Prime and touch up marred finished paintwork to match original. Touch-up to match original paint. Do not paint over nameplates.
- .3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.
- .4 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated equipment.

**1.12 DEMONSTRATION, OPERATING AND MAINTENANCE INSTRUCTIONS**

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Where specified elsewhere in the specifications, the contractor is to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, as built drawings, audio visual aids, etc. as part of instruction materials.

- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, the Departmental Representative may record these demonstrations on video tape for future reference.

**1.13 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 11 00 – General Requirements.
- .2 Storage and Protection:
  - .1 Store materials indoors in dry location.
  - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

**1.14 AS INDICATED**

- .1 Means that the item or items specified are shown on the drawings.
- .2 The word "provide" shall mean "Supply and Install".

**1.15 EQUIPMENT REQUIREMENTS AND INSTALLATION**

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.
- .2 Pipe all drain lines to floor drains.
- .3 Equipment shall be installed on the axis of the building.

**1.16 ANCHOR BOLTS AND TEMPLATES**

- .1 Supply anchor bolts.
- .2 Drill and grout anchor bolts using templates.
- .3 Installed anchors shall perform to criteria required.

**1.17 SLEEVES**

- .1 Provide pipe sleeves at all points where pipes pass through masonry or concrete walls or slabs.
- .2 Also refer to Item 1.26 Cutting and Patching and Division 01 – General Requirements.
- .3 Sleeves to be primed coated prior to installation.
- .4 Sizes:
  - .1 Provide ½" (13mm) clearance all around between sleeve and pipes or between sleeve and insulation. Clearance around pipes penetrating fire rated walls and floors to be as required for fire stopping.

- .2 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and all finished areas; and 2" (50mm) above floors in mechanical rooms, service spaces and wet areas such as kitchens, etc.
- .5 Fill voids around pipes.
- .6 Also, refer to Item 1.22 Penetration of Walls and Floor Slabs.
- .7 All fire stopping to be done in accordance with Section 07 84 00 – Firestopping.
- .8 Temporarily plug all openings during construction.
- .9 Provide sleeves in all openings in mechanical room and wet area floors.
- .10 Sleeves to be Schedule 40 steel pipe complete with continuous welded fin.
- .11 Sleeves to be installed when concrete is poured.

#### **1.18 ESCUTCHEONS AND PLATES**

- .1 Provide on all pipes passing through finished walls, partitions, floors and ceilings.
- .2 Use chrome or nickel plated brass, split type with set screws for ceiling or wall mounting.
- .3 Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.
- .4 Secure to pipe or finished surface but not to insulation.
- .5 Where sleeves extend above finished floor, escutcheons or plates shall cover sleeve extension.

#### **1.19 ACCESS DOORS**

- .1 Supply access doors for furred ceilings and duct shafts or spaces for servicing equipment and accessories or for inspection of safety, operating or fire devices for installation under section erecting the walls or ceilings. Also, supply and arrange for installation of access pits and covers for servicing and inspection of valves, devices which are to be installed below grade or below floor in floor slabs.
- .2 General: Prime coated steel.
- .3 Special areas such as tiled or marble surfaces: stainless steel.
- .4 In visible areas, access door locations to be approved by the Departmental Representative prior to installation.

#### **1.20 DIELECTRIC COUPLINGS**

- .1 Provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes 2" (50mm) and under and flanges for pipe sizes over 2" (50mm).
- .3 Provide felt or rubber gaskets to prevent dissimilar metals contact.

## **1.21 PENETRATION OF WALLS AND FLOOR SLABS**

- .1 Wherever pipes and ducts penetrate non-fire rated walls and floor slabs, tightly pack the space between construction and ducts/pipes the full depth with acoustic filler material and seal both sides with acoustic sealant. Where pipes pass through fire rated walls and floor slabs, pack space between the pipe and sleeve with approved fire rated and ULC approved sealant.
- .2 Acoustic Filler:
  - .1 Filler material shall be glass fibre or inorganic mineral.
  - .2 Filler material shall not have higher combustion rating than the following:
  - .3 Flame Spread Rating = 25
  - .4 Smoke Development Rating = 0
  - .5 Fuel Contribution Rating = 0
- .3 Acoustic Sealant:
  - .1 Concealed Application: Non-shrinking, non-straining, non-drying and permanently elastic type.
  - .2 Exposed Application: Permanently elastic, paintable acoustic sealant, latex acrylic or acrylic latex type.

## **1.22 PREPARATION FOR FIRE STOPPING**

- .1 Fire stopping material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to be ULC listed and acceptable to the Authority Having Jurisdiction. Installation to be as per manufacturer's recommendations and ULC's testing procedure and to section 07 84 00 – 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 to move without damaging fire stopping material.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barrier at fire separation.
- .5 Each Trade contractor shall be responsible for their own fire stopping.
- .6 Fire stopping shall be located at the penetration of the fire separation by a fire stopping System in accordance with ULC-S155 "Fire Tests of Fire Stop Systems" that has a rating of not less than the rating for the fire separation.
- .7 Fire stop systems shall be installed by qualified personnel.

## **1.23 DRAWINGS**

- .1 Mechanical drawings are not intended to show structural details or Architectural features.
- .2 The Mechanical drawings are not to be scaled.
- .3 Except where dimensioned, mechanical drawings indicate general Mechanical layouts only. Because of the small scale of Mechanical drawings, it is not possible to show all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories which are required to meet the conditions.

- .4 These specifications are to be considered as an integral part of the drawings which accompany them; neither the drawings nor the specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other, shall be considered properly and sufficiently specified and must, therefore, be provided under the Contract. The decision of the Departmental Representative shall be final, if interpretation is required.
- .5 Misinterpretation of drawings and specifications shall not relieve the Plumbing Trade Contractor of responsibility.
- .6 The Plumbing Trade Contractor shall make themselves familiar with the overall intended operation of the plumbing system prior to installation so that all necessary accessories can be installed during the normal progress of the work. Failure to do so will result in the Plumbing Trade Contractor being responsible for providing such devices, at their expense when the need of such devices becomes apparent during start-up.

#### **1.24 EXISTING SITE CONDITIONS**

- .1 The Contractor shall visit the site of the building in order to examine firsthand the existing conditions which may affect his contract. No compensation shall be considered for additional expenditures incurred later through failure to do so.

#### **1.25 CUTTING AND PATCHING**

- .1 Any cutting, coring and patching required shall be done by the Contractor for as per Division 01 – General Requirements.
- .2 Holes in slabs shall be by coring and are the responsibility of this Contractor in locations to be approved by the Departmental Representative.
- .3 Where any masonry and concrete saw cutting and coring work is required the Contractor shall wet cut to reduce dust.
- .4 Approvals:
  - .1 Obtain approval from the Authority Having Jurisdiction beginning installation.
  - .2 Contractor to provide stamped shop drawings and piping layout drawings to the Authority Having Jurisdiction.
  - .3 Pay all costs associated with such approvals, including but not limited to checking of documents.

#### **1.26 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 11 00 – General Requirements.

#### **1.27 COMPLETION**

- .1 This Trade shall be held responsible to provide and furnish all necessary labour and to bear all expenses incidental to the satisfactory completion of the work.

#### **1.28 MANUFACTURERS REVIEW**

- .1 It shall be the responsibility of the Contractor to have the equipment supplier or his representative review all proposed connections, clearances, sizes, valves, breakers, etc. including wire and pipe sizes to his equipment before installation commences. At that time,

he shall inform the Departmental Representative of any changes required to make the equipment function satisfactorily.

- .2 Provide the Contractor with a letter accepting all connections as proposed and where required, recommend necessary changes.
- .3 If any changes or additional material and labour are required to make the equipment function properly to capacity and the manufacturer has not pointed out this work prior to commencement of work, the additional and/or corrective work shall then be done at the expense of the equipment supplier.

#### **1.29 WARRANTIES**

- .1 Make good all defects other than normal wear and tear during the life of the warranty period specified in the General Conditions of the contract. Warrant all work and installed equipment to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the warranty. At any time during this period, make any necessary changes and adjustments, or replacements, to accomplish this at no additional cost to the Departmental Representative.

#### **1.30 COORDINATION**

- .1 Co-ordinate work with other trades to avoid conflict.
- .2 Locate distribution systems, equipment and materials to provide minimum interference and maximum useable space.
- .3 Co-ordinate location of pipe drops and risers with trades erecting walls and ceilings to ensure that all pipes and ducts are concealed in walls or ceilings spaces. If space is not available in walls or ceilings, locate pipes so that they can be easily boxed in by the relevant trades. Where pipes are shown rising in concrete block walls, placement of the pipe shall be done in conjunction with the erection of the wall.

#### **1.31 GUARANTEE**

- .1 This Plumbing Trade Contractor shall guarantee all their work free from defects for a period of one year, unless specifically noted otherwise, after final acceptance of such work by the Departmental Representative and shall make good all defects other than normal wear and tear during the life of the guarantee.
- .2 This Plumbing Trade Contractor shall guarantee all work and equipment supplied by them to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the above guarantee.
- .3 At any time during this period, they shall make any necessary changes and adjustments or replacements, to accomplish this at their own expense.

#### **1.32 PERMITS AND REGULATIONS**

- .1 The plumbing Trade Contractor shall comply with all regulations of authorities having jurisdiction, where applicable, including but not limited to the following:
  - .1 Provincial Department of Labour.
  - .2 Municipal Plumbing Inspector.
- .2 The Plumbing Trade Contractor shall obtain and pay for any permits required by Local Codes and Regulations and arrange for inspections.



- .3 Any additional materials or labour required to conform to any of these rules and regulations will be furnished under the Contract with no additional cost to the Departmental Representative.

### **1.33 TESTS**

- .1 Notice of Tests: Give written notice for a minimum of four (4) working days prior to date when tests will be made.
- .2 Prior Tests: Concealed work shall remain uncovered until completely tested and approved, but if construction schedule requires, arrange for prior tests on parts of system as approved.
- .3 Acceptance Tests: Conduct in presence of the Departmental Representative and representative of the Authorities Having Jurisdiction.
- .4 Costs: Bear all costs in connection with tests conducted.
- .5 Certificates: Obtain acceptance certificates from the authorities having jurisdiction. Work is not considered complete until certificates have been delivered to the Departmental Representative.

### **1.34 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .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 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 banding, flatten and place in designated area for recycling.

### **1.35 COMMISSIONING**

- .1 Building Commissioning as per Division 01.
- .2 Provide start-up reports for all equipment. Provide TAB reports for domestic water systems.
- .3 Provide 4 hours of training for building operators.

## **PART 2 PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used

**PART 3        EXECUTION**

**3.1            NOT USED**

.1        Not Used

END

**PART 1 GENERAL**

**1.1 GENERAL CONDITIONS**

- .1 Division 01 – General Requirements and Section 23 05 00 – Common Works Results - Mechanical are both part of this Section and shall apply as if repeated here.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 22 05 00 – Common Work Results for Plumbing.
- .3 Section 22 11 17 – Domestic Water Piping –Plastic.
- .4 Section 22 30 05 – Domestic Water Heaters.
- .5 Section 22 42 01 – Plumbing Specialities and Accessories.
- .6 Section 23 05 00 – Common Work Results – Mechanical.
- .7 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
- .8 Section 23 05 53 – Mechanical Identification.
- .9 Section 23 04 93 – Testing, Adjusting and Balancing for HVAC.
- .10 Section 23 07 20 – Thermal Insulation for Piping.

**1.3 REFERENCE STANDARDS**

- .1 National Plumbing Code of Canada - 2015, including latest errata.
- .2 National Building Code of Canada - 2015, including latest errata.
- .3 National Fire Code of Canada - 2015, including latest errata.
- .4 Authorities Having Jurisdiction:
  - .1 Conform to the requirements of the Authority Having Jurisdiction

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Submit close out documentation in accordance with in accordance with 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.
- .2 Data to include:
  - .1 Manufacturers name, type, model, year, capacity and serial number.
  - .2 Details of operation, servicing and maintenance.

- .3 Recommended spare parts list with names and addresses.

## **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 11 00 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

## **PART 2 PRODUCTS**

### **2.1 DOMESTIC HOT WATER RECIRCULATION PUMP**

- .1 Construction: wet rotor, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve
- .2 Motor: ECM, drip proof, with thermal overload protection.
- .3 Capacity: As per drawings
- .4 Control: Pump shall be equipped with a controller and a temperature sensor. Pump shall cycle to maintain fluid temperature in the line.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Application Tolerances:
  - .1 Flow: plus 10%; minus 0%.
  - .2 Pressure: plus 10%; minus 5%.
- .2 Check removability of pumps for servicing without interfering with installation or operation of other equipment.

### **3.2 COMMISSIONING**

- .1 Building Commissioning as per Division 01 and 22 05 00 – Common Work Results for Plumbing.

END

**PART 1        GENERAL**

**1.1            GENERAL CONDITIONS**

- .1        Division 01 – General Requirements and Section 23 05 00 – Common Works Results - Mechanical are both part of this Section and shall apply as if repeated here.

**1.2            RELATED SECTIONS**

- .1        Division 01 – General Requirements.
- .2        Section 22 05 00 – Common Work Results for Plumbing.
- .3        Section 22 13 17 – Drainage, Waste and Vent Piping – Cast Iron and Copper.
- .4        Section 22 13 18 – Drainage, Waste and Vent Piping – Plastic.
- .5        Section 22 30 05 – Domestic Water Heaters.
- .6        Section 22 42 01 – Plumbing Specialities and Accessories.
- .7        Section 23 05 00 – Common Work Results – Mechanical.
- .8        Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .9        Section 23 05 53 – Mechanical Identification.
- .10      Section 23 07 20 – Thermal Insulation for Piping.

**1.3            REFERENCE STANDARDS**

- .1        National Plumbing Code of Canada - 2015, including latest errata.
- .2        National Building Code of Canada - 2015, including latest errata.
- .3        National Fire Code of Canada - 2015, including latest errata.
- .4        Authorities Having Jurisdiction:
  - .1        Conform to the requirements of the Authority Having Jurisdiction.
- .5        ANSI B16.15 – 2006 - Cast Bronze Threaded Fittings, Classes 125 and 250.
- .6        ANSI B16.18 – 2001 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .7        ANSI B16.22 – 2001 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .8        ANSI B16.24 – 2001 - Cast Copper Alloy Pipe Flanges and Flanged Fittings
- .9        ASTM B88-09 - Specification for Seamless Copper Water Tube.

**1.4            SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit close out documentation in accordance with in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.
- .2 Data to include:
  - .1 Valves;
  - .2 Grooved Couplings; and
  - .3 Grooved Fittings.

## **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 11 00 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

## **PART 2 PRODUCTS**

### **2.1 PIPING**

- .1 Domestic hot and cold systems within building:
  - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88.
  - .2 Buried and embedded: copper tube, soft annealed, type K: to ASTM B88, in long lengths and with no buried joints.
- .2 Trap Primer piping:
  - .1 Above floor: Type “L” copper tube to ASTM B88.
  - .2 Buried and embedded: copper tube, soft annealed, type K: to ASTM B88, in long lengths and with no buried joints.

### **2.2 FITTINGS**

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI 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 (lead-free).
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 Piping 50mm (2") and larger: Roll grooved to CSA B242, ASTM B75 alloy C12200.

### **2.3 JOINTS**

- .1 Rubber gaskets, 1.6 mm thick: to ANSI/AWWA C111/A21.11.
- .2 Bolts, nuts, hex head and washers: to ASTM A 307, heavy series.
- .3 Solder: tin-antimony to ASTM B32 (lead free); Silfos for piping greater than 1½ diameter.
- .4 Teflon tape: for threaded joints.

- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket, heat treated carbon steel bolts and nuts to ASTM A183.
- .6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F 492, complete with thermoplastic liner.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with National Plumbing Code of Canada except where specified otherwise.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Assemble all piping using fittings manufactured to ANSI standards.
- .4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .5 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.

### **3.2 DISINFECTION**

- .1 Flush out, disinfect and rinse system to requirements of Authority Having Jurisdiction. After testing, provide acceptable water quality test report to Departmental Representative for review.

### **3.3 PRESSURE TESTING**

- .1 Test at the greater of 1-1/2 times maximum system operating pressure or 860kPa (125 psig) for four (4) hours without loss of pressure.
- .2 Give Departmental Representative 48 hours' prior notice for witnessing of tests.

END

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Potable hot and cold water and non-potable water distribution systems, using cross-linked polyethylene (PEX) tubing and ASTM F1960 cold expansion fittings.
- .2 Sustainable requirements for construction verification and operation.

**1.2 RELATED SECTIONS**

- .1 Section 01 11 00 – General Requirements.
- .2 Section 23 05 00 – Common Work results for Mechanical

**1.3 REFERENCES**

- .1 General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- .2 American Society for Testing and Materials (ASTM):
  - .1 ASTM F876, ASTM F877 and ASTM F1960
- .3 Canadian Standards Association (CSA):
  - .1 CAN/CSA B137.5
- .4 National Sanitation Foundation (NSF):
  - .1 NSF/ANSI 14 and 61.
- .5 Underwriters' Laboratories of Canada Inc:
  - .1 CAN/ULC-S101, CAN/ULC-S115 and CAN/ULC-S102.2

**1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 11 00 – General Requirements.
- .2 Submit product data for following: valves, piping and fittings.
- .3 Regulatory Listings: Submit applicable UL, ULC, Warnock Hersey, Intertek or QAI and CSA or NSF listings as proof of compliance with Federal, Provincial and Municipal building and plumbing codes. Listings shall include the following:
  - .1 Fire rated assemblies: CAN/ULC-S101 listing for PEX tubing incorporated in or traversing a fire rated floor/ceiling assembly or wall assembly.
  - .2 Fire stop: CAN/ULC-S115 listing where the PEX tubing penetrates a fire separation.
  - .3 Flame spread / smoke developed: CAN/ULC-S102.2 listing for maximum 25 flame spread and maximum 50 smoke developed.
  - .4 PEX plumbing: CAN/CSA-B137.5 listing for all PEX tubing, fittings and accessories.
- .4 Submit WHMIS MSDS -Material Safety Data Sheets in accordance with Section 01 11 00 – General Requirements.



- .5 Provide maintenance data for incorporation into manual specified in Section 01 11 00 – General Requirements.

## **1.5 HEALTH AND SAFETY**

- .1 Do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

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

- .1 General: Comply with Division 1 – General Requirements.
- .2 Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- .3 Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .4 Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - .1 Store PEX tubing in cartons or under cover to avoid dirt or foreign material from being introduced into the tubing.
  - .2 Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of tubing exposed to direct sunlight.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 00 – General Requirements.
- .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 and 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 and Regional and Municipal regulations.
- .6 Fold up metal banding, flatten and place in designated area for recycling.

## **1.9 QUALITY ASSURANCE**

- .1 Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of PEX plumbing installation training by the PEX tubing manufacturer.
- .2 Regulatory Requirements and Approvals: Provide domestic potable systems that complies with requirements of the following:
  - .1 International Code Conference: ICC Evaluation Service (ES) Evaluation Report No. ESR 1099.
  - .2 Building Officials and Code Administrators International (BOCA): 1993 BOCA

National Building Code.

.3 Uniform Plumbing Code (UPC): IAPMO Files 3558, 3946 and 3960.

.4 National Standard Plumbing Code (NSPC).

.5 HUD Material Release NO. 1269.

.3 Certifications: Provide letters of certification as follows:

.1 Installer is trained by the PEX tubing manufacturer to install the PEX potable water distribution system.

.2 Installer will utilize skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed tradesperson.

## **1.10 WARRANTY**

.1 Project Warranty: Refer to Conditions of Contract for project warranty provisions.

.2 Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

.1 Warranty shall provide for repair or replacement of any tube or fittings that are proven to be defective.

.2 Warranty shall be transferable to subsequent Owners.

.3 Warranty Period for tubing used with Manufacturer's fitting systems: 25 year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.

.4 Warranty Period for fittings used with manufacturer's tubing: 25 year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.

## **Part 2 Products**

### **2.1 PEX POTABLE WATER DISTRIBUTION SYSTEM**

.1 All PEX tubing, fittings and fitting assemblies shall be by one manufacturer.

.2 All PEX tubing, PEX rings and PEX fittings from the same manufacturer have been tested together and certified as a system.

.3 All building domestic water piping, except for the water entrance piping up to the point indicated on the drawings, shall be PEX.

### **2.2 MATERIALS**

.1 Tube Materials: Tube shall be cross-linked polyethylene (PEX) manufactured by PEX-a or peroxide method.

.1 PEX tubing shall be ASTM F876 tested and approved for excessive temperature and pressure for 725 hours at 210 degrees F (99 degrees C) @ 150 psi (1035 kPa).

.2 PEX tubing shall be manufactured in accordance with ASTM F876, ASTM F877 and CAN/CSA-B137.5. The tube shall be listed to ASTM by an independent third party agency.

.3 PEX tubing shall be listed to both NSF/ANSI 14 and 61.

.4 PEX tubing shall have Standard Grade hydrostatic design and pressure ratings of

- 200 F (82 degrees C) at 80 psi (551 kPa), 180 degrees F (82 degrees C) at 100 psi (689 kPa), and 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa). Temperature and pressure ratings shall be issued by the Plastic Pipe Institute (PPI), a division of the Society of the Plastic Industry (SPI).
- .5 Minimum bend radius for cold bending of the PEX tubing shall not be less than six (6) times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by tube manufacturer.
  - .2 Fittings Connections: All connections to the PEX tubing shall be made to the requirements of ASTM F1960.
  - .3 Pre-Sleeved Tubing: All PEX tubing that is encased in concrete shall be pre-sleeved in corrugated polyethylene tubing.
    - .1 Pre-sleeved tubing shall be supplied by the PEX tubing manufacturer.
  - .4 Pre-Insulated Tubing: To meet insulation requirements as per Section 23 07 20 – Thermal Insulation for Piping.
    - .1 Pre-insulated tubing shall be supplied by the PEX tubing manufacturer.
  - .5 Manifold Materials: Manifolds shall be manufactured of Engineered Polymers (EP). Manifold connections shall be made to the requirements of ASTM F1960.
    - .1 Manifolds shall be supplied by the PEX tubing manufacturer.
    - .2 PEX-a cold expansion type manifolds shall be an assembly consisting of insert and PEX-a cold expansion ring.
  - .6 Multi-Port Tee Materials: Multi-Port Tee's shall be manufactured of Engineered Polymers (EP). Multi-Port Tee connections shall be made to the requirements of ASTM F1960.
    - .1 Multi-Port Tee's shall be supplied by the PEX tubing manufacturer.
    - .2 PEX-a cold expansion type manifolds shall be an assembly consisting of insert and PEX-a cold expansion ring.
  - .7 Fitting Materials: Fittings shall be manufactured of Engineered Polymer (EP). Lead free brass materials are allowed only for transition fittings. Fitting connections shall be made to the requirements of ASTM F1960.
    - .1 Fittings shall be supplied by the PEX tubing manufacturer.
    - .2 PEX-a cold expansion type fittings shall be an assembly consisting of insert and PEX-a cold expansion ring.
  - .8 Insulation Materials: As per Section 23 07 20 – Thermal Insulation for Piping.

## **2.3 ACCESSORIES**

- .1 Fixture Shut-Off Valves: Fixture Shut-Off valves shall be supplied by the PEX tubing manufacturer.
- .2 Tubing Wall Penetration Brackets: Brackets designed for tubing wall membrane penetrations shall be supplied by PEX tubing manufacturer.
- .3 Horizontal Pipe Support Channels: Provide horizontal pipe supports for all PEX sizes piping. Channels shall be galvanized steel channels.
- .4 Riser Clamps: All PEX riser clamps shall be epoxy coated.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings.

**3.2 EXAMINATION**

- .1 Site Verification of Conditions:
  - .1 Verify that site conditions are acceptable for installation of the PEX potable water system.
  - .2 Do not proceed with installation of the PEX potable water system until unacceptable conditions are corrected.

**3.3 INSTALLATION**

- .1 Tubing:
  - .1 Install tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
  - .2 Do not install PEX tubing within 6" (152mm) of gas appliance vents or within 12" (305mm) of any recessed light fixtures.
  - .3 Do not solder within 18" (457mm) of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
  - .4 Do not expose PEX tubing to direct sunlight for more than 30 days.
  - .5 Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
  - .6 Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
  - .7 Protect PEX tubing with sleeves where abrasion may occur.
  - .8 Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
  - .9 Use tubing manufacturer supplied, and bend supports where bends are less than six times the outside pipe diameter.
  - .10 Minimum horizontal supports are to be installed not less than 32" between hangers in accordance with model plumbing codes and the installation handbook.
  - .11 PEX riser installations require epoxy-coated riser clamps installed at the base of the ceiling per floor.
  - .12 A mid-story support is required for riser applications.
  - .13 Pressurize tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.
  - .14 Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressure the system if ambient air temperature has the possibility of dropping below 32°F (0°C).
- .2 Through Penetration Firestop:
  - .1 Ensure compliance of one and two-hour rated through penetration assemblies in accordance with ASTM E814.
  - .2 A list of firestop manufacturers that list PEX tubing with their firestop systems is available from the PEX tubing manufacturer.
- .3 Related Products Installation: Refer to other sections listed in Related Sections paragraph

herein for related products installation.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: Flush entire system for 8 hrs. Ensure outlets flushed for 2 hrs. Let stand for 24 hrs, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial or Federal potable water guidelines. Let system flush for additional 2 hrs., then draw off another sample for testing.
- .2 Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

### **3.5 CLEANING**

- .1 Remove temporary coverings and protection of adjacent work areas.
- .2 Repair or replace damaged installed products.
- .3 Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
- .4 Remove construction debris from project site and legally dispose of debris.

### **3.5 PROTECTION**

- .1 Protect installed work from damage due to subsequent construction activity on the site.

END

**PART 1        GENERAL**

**1.1            GENERAL CONDITIONS**

- .1       Division 01 – General Requirements and Section 23 05 00 – Common Works Results - Mechanical are both part of this Section and shall apply as if repeated here.

**1.2            RELATED SECTIONS**

- .1       Division 01 – General Requirements.
- .2       Section 22 05 00 – Common Work Results for Plumbing.
- .3       Section 22 11 16 – Domestic Water Piping – Copper.
- .4       Section 22 13 18 – Drainage, Waste and Vent Piping – Plastic.
- .5       Section 22 30 05 – Domestic Water Heaters.
- .6       Section 22 42 01 – Plumbing Specialities and Accessories.
- .7       Section 23 05 00 – Common Work Results – Mechanical.
- .8       Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .9       Section 23 05 53 – Mechanical Identification.
- .10      Section 23 07 20 – Thermal Insulation for Piping.

**1.3            REFERENCE STANDARDS**

- .1       National Plumbing Code of Canada - 2015, including latest errata.
- .2       National Building Code of Canada - 2015, including latest errata.
- .3       National Fire Code of Canada - 2015, including latest errata.
- .4       Authorities Having Jurisdiction:
  - .1       Conform to the requirements of the Authority Having Jurisdiction.
- .5       American Society for Testing and Materials (ASTM)
  - .1       ASTM B 32 96, Specification for Solder Metal.
  - .2       ASTM B 306 99, Specification for Copper Drainage Tube (DWV).
  - .3       ASTM C 564 95a, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .6       CSA B67 1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
- .7       CAN/CSA B70 97, Cast Iron Soil Pipe, Fittings and Means of Joining.
- .8       CAN/CSA B125 98, Plumbing Fittings.

#### **1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit close out documentation in accordance with in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

#### **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 11 00 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

### **PART 2 PRODUCTS**

#### **2.1 COPPER TUBE AND FITTINGS**

- .1 Piping:
  - .1 Above grade Sanitary and Vent, 50mm (2") and smaller, Type DWV to: ASTM B306.
- .2 Fittings:
  - .1 Cast brass: to CSA B158.1.
  - .2 Wrought copper: to ANSI B16.29.
  - .3 Solder: lead free.

#### **2.2 CAST IRON PIPING AND FITTINGS**

- .1 Piping:
  - .1 Below grade: Sanitary, Storm and Vent: to CAN/CSA B70.
  - .2 Above grade: Sanitary, Storm and Vent, 65mm (2.1/2") and larger: to CAN3-B70.
- .2 Fittings:
  - .1 Mechanical joints:
    - .1 Above grade: Neoprene or butyl rubber compression gaskets with stainless steel clamps.
    - .2 Below Grade: Heavy Duty Neoprene or butyl rubber compression gaskets with stainless steel clamps.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Provide fire stopping at all piping penetrations of fire separations.
- .2 Install buried pipe on 150mm (6") bed of clean washed sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with 150mm (6") of clean washed sand.

- .3 Install piping parallel and close to walls and ceilings to conserve headroom and space, and to grade indicated.
- .4 Where inverts are not given and pipe size is 75mm (3") and under, pipe shall run at uniform grade of 7mm per 305mm (1/4" per 1'-0"), pipe size 100mm (4") and over, pipe shall run at uniform grade of 3mm per 305mm (1/8" per 1'-0").
- .5 During construction, all open ends of pipe and fittings shall be plugged or capped to keep out debris.
- .6 Run buried drain piping minimum 200mm (8") clear below underside of concrete slabs.
- .7 Ensure that copper pipe does not come in contact with concrete grouting, mortar, etc.
- .8 Install in accordance with National Plumbing Code of Canada.
- .9 A cleanout, easily accessible, shall be provided to each alternate change in direction in main soil or waste pipe and at the base of each stack. All cleanouts shall be of the same nominal size as the pipes up to 100mm (4") and not less than 100mm (4") for larger pipes. The distance between cleanouts in horizontal soil and waste lines shall not exceed 15m (50ft) in pipe 100mm (4") and smaller and 26m (85ft) in pipe 150mm (6") and larger.
- .10 Start laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.

### **3.2 TESTING**

- .1 Complete storm, sanitary and vent piping systems shall be tested with water to withstand a 3.05m (10 foot) head for 60 minutes without leakage. An air test of 103kPa (15 psi) for 120 minutes without leakage is acceptable in freezing conditions.
- .2 Give Departmental Representative 48 hours' prior notice for witnessing of tests.

### **3.3 COMMISSIONING**

- .1 Building Commissioning as per Division 01.

END



**PART 1 GENERAL**

**1.1 GENERAL CONDITIONS**

- .1 Division 01 – General Requirements and Section 23 05 00 – Common Works Results - Mechanical are both part of this Section and shall apply as if repeated here.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 22 05 00 – Common Work Results for Plumbing.
- .3 Section 22 11 16 – Domestic Water Piping – Copper.
- .4 Section 22 13 17 – Drainage, Waste and Vent Piping – Cast Iron and Copper.
- .5 Section 22 30 05 – Domestic Water Heaters.
- .6 Section 22 42 01 – Plumbing Specialities and Accessories.
- .7 Section 23 05 00 – Common Work Results – Mechanical.
- .8 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .9 Section 23 05 53 – Mechanical Identification.
- .10 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .11 Section 23 07 20 – Thermal Insulation for Piping.

**1.3 REFERENCE STANDARDS**

- .1 National Plumbing Code of Canada - 2015, including latest errata.
- .2 National Building Code of Canada - 2015, including latest errata.
- .3 National Fire Code of Canada - 2015, including latest errata.
- .4 Authorities Having Jurisdiction:
  - .1 Conform to the requirements of the Authority Having Jurisdiction
- .5 ASTM D 2564 96a, Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.
- .6 CSA B181.2 M1996, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
- .7 CSA B182.1 M1996, Plastic Drain and Sewer Pipe and Pipe Fittings.

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Submit close out documentation in accordance with in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

**1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 11 00 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

**PART 2 PRODUCTS**

**2.1 PLASTIC PIPING**

- .1 Above and Below grade: Sanitary drainage and vent piping to CAN/CSA-B181.2-M for PVC DWV.
- .2 Below grade: Storm drainage to be PVC, Type SDR 35.
- .3 Above grade: Sanitary, vent and storm drainage piping in ceiling plenums to CAN/ULC-S102.2.

**2.2 JOINTS**

- .1 Solvent weld for PVC: to ASTM D2564.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Provide fire stopping at all piping penetrations of fire separations.
- .2 Install buried pipe on 150mm (6") bed of clean washed sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with 150mm (6") of clean washed sand.
- .3 Install piping parallel and close to walls and ceilings to conserve headroom and space, and to grade indicated.
- .4 Where inverts are not given and pipe size is 75mm (3") and under, pipe shall run at uniform grade of 7mm per 305mm (1/4" per 1'-0"), pipe size 100mm (4") and over, pipe shall run at uniform grade of 3mm per 305mm (1/8" per 1'-0")
- .5 During construction, all open ends of pipe and fittings shall be plugged or capped to keep out debris.
- .6 Run buried drain piping minimum 200mm (8") clear below underside of concrete slabs.
- .7 Install in accordance with National Plumbing Code of Canada.
- .8 A cleanout, easily accessible, shall be provided to each alternate change in direction in main soil or waste pipe and at the base of each stack. All cleanouts shall be of the same nominal size as the pipes up to 100mm (4") and not less than 100mm (4") for larger pipes.

The distance between cleanouts in horizontal soil and waste lines shall not exceed 15m (50ft) in pipe 100mm (4") and smaller and 26m (85ft) in pipe 150mm (6") and larger.

- .9 Start laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.
- .10 Install gaskets in accordance with manufacturer's published instructions. During cold weather store gaskets in heated area to assure flexibility.
- .11 Align pipe carefully before joining. Do not use excessive force to join pipe sections.
- .12 Support pipes as required to assure concentricity until joint is properly completed.
- .13 Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, re-install, and lubricate gaskets so disturbed.
- .14 Where deflection at joint is permitted, deflect only after joint is completed. Do not exceed maximum joint deflection recommended by the manufacturer.

### **3.2 TESTING**

- .1 Complete storm, sanitary and vent piping systems shall be tested with water to withstand a 3.05 m (10 foot) head for 60 minutes without leakage. An air test of 103kPa (15 psi) for 120 minutes without leakage is acceptable in freezing conditions.
- .2 Give Departmental Representative 48 hours' prior notice for witnessing of tests.

### **3.3 COMMISSIONING**

- .1 Building Commissioning as per Division 01

END

**PART 1 GENERAL**

**1.1 GENERAL CONDITIONS**

- .1 Division 01 – General Requirements and Section 23 05 00 – Common Works Results - Mechanical are both part of this Section and shall apply as if repeated here.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 01 11 00 – General Requirements.
- .3 Section 22 05 00 – Common Work Results for Plumbing.
- .4 Section 22 10 10 – Plumbing Pumps.
- .5 Section 22 11 16 – Domestic Water Piping – Copper.
- .6 Section 22 13 17 – Drainage, Waste and Vent Piping – Cast Iron and Copper.
- .7 Section 22 13 18 – Drainage, Waste and Vent Piping – Plastic.
- .8 Section 22 42 01 – Plumbing Specialities and Accessories.
- .9 Section 23 05 00 – Common Work Results – Mechanical.
- .10 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .11 Section 23 05 53 – Mechanical Identification.
- .12 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .13 Section 23 07 20 – Thermal Insulation for Piping.

**1.3 REFERENCE STANDARDS**

- .1 National Building Code of Canada - 2015, including latest errata.
- .2 National Plumbing Code of Canada - 2015, including latest errata.
- .3 National Fire Code of Canada - 2015, including latest errata.
- .4 Authorities Having Jurisdiction:
  - .1 Conform to the requirements of the Authority Having Jurisdiction.
- .5 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements: Submittal Procedures and Section 22 05 00 – Common Work Results for Plumbing.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit close out documentation in accordance with in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

## **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 11 00 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements: Health and Safety.

## **PART 2 PRODUCTS**

### **2.1 ELECTRIC HOT WATER HEATER**

- .1 The CUL seal of certification and be factory equipped with an AGA/ASME rated temperature and pressure relief valve.
- .2 Tanks shall have a baked enamel finish and be cathodically protected with powered anodes.
- .3 Water heater(s) shall meet or exceed the standby loss requirements of latest ASHRAE Standards.
- .4 Tanks shall have a working pressure of 1035 kPa (150 psi) and shall be completely assembled.
- .5 Water heaters shall be approved-listed and constructed in accordance with UL Sanitation (NSF5).
- .6 Tank shall be insulated with foam insulation.
- .7 Water heaters shall be covered by a three (3) year limited warranty against tank leaks.
- .8 Electrical: as per drawings
- .9 Capacity: as per drawings

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Tanks to be set level on concrete housekeeping pads. Housekeeping pads to be by this contractor and to be 100mm (4") high and a minimum of 75mm (3") larger all the way around than the equipment.
- .2 Install in accordance with manufacturers recommendations and as indicated.
- .3 Set water heater controls to maintain a water temperature of 60°C (140°F) for domestic use.
- .4 Run drain line from unit to nearest floor drain.

**3.2 COMMISSIONING**

- .1 Building Commissioning as per Division 01 and 22 05 00 – Common Work Results for Plumbing.

END

**PART 1 GENERAL**

**1.1 GENERAL CONDITIONS**

- .1 Division 01 – General Requirements and Section 23 05 00 – Common Works Results - Mechanical are both part of this Section and shall apply as if repeated here.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 22 05 00 – Common Work Results for Plumbing.
- .3 Section 22 11 16 – Domestic Water Piping – Copper.
- .4 Section 22 11 17 – Domestic Water Piping – Plastic.
- .5 Section 22 13 17 – Drainage, Waste and Vent Piping – Cast Iron and Copper.
- .6 Section 22 13 18 – Drainage, Waste and Vent Piping – Plastic.
- .7 Section 22 30 05 – Domestic Water Heaters.
- .8 Section 23 05 00 – Common Work Results – Mechanical.
- .9 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .10 Section 23 05 53 – Mechanical Identification.
- .11 Section 23 07 20 – Thermal Insulation for Piping.

**1.3 REFERENCE STANDARDS**

- .1 National Plumbing Code of Canada - 2015, including latest errata.
- .2 National Building Code of Canada - 2015, including latest errata.
- .3 National Fire Code of Canada - 2015, including latest errata.
- .4 Authorities Having Jurisdiction:
  - .1 Conform to the requirements of the Authority Having Jurisdiction
- .5 CAN/CSA B64 Series-01- Backflow Preventers and Vacuum Breakers.
- .6 ASSE 1010-2004 -Water Hammer Arresters

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Submit close out documentation in accordance with in accordance with Section 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

## **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 11 00 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

## **PART 2 PRODUCTS**

### **2.1 BACKFLOW PREVENTERS**

- .1 To CAN/CSA-B64.
- .2 Type:
  - .1 Double check valve assembly with shut-off valves.

### **2.2 CLEANOUTS**

- .1 Above ground unfinished areas and concealed finished areas: cast iron with brass screws and neoprene gasket.
- .2 Access covers:
  - .1 Wall access: face or wall type, polished nickel bronze square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
- .3 Floor access: Round cast iron body and frame with heavy duty adjustable secured nickel bronze top.

### **2.3 FLOOR DRAINS**

- .1 All floor drains to have fusion bonded epoxy cast iron bodies and clamp collars, polished nickel bronze adjustable strainer head and grate w/trap primer connections unless noted otherwise:
- .2 FD (Standard Floor Drains):
  - .1 Finished Spaces: General duty, cast iron body, round, adjustable head, sediment basket, nickel bronze strainer, integral seepage pan, clamping collar and trap primer connection.
- .3 FFD (Funnel Floor Drains):
  - .1 Combination funnel floor drain, cast iron body, integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral oval funnel, sediment basket and trap primer connection.

### **2.4 STRAINERS**

- .1 50mm and under (2" and under):
  - .1 861kPa (125 psig), Y type with 20 mesh, monel, bronze or stainless steel removable screen. Bronze body, screwed ends, with brass cap.
- .2 63mm and over (2.1/2" and over):
  - .1 861kPa (125 psig), Y type with 20 mesh, monel, bronze or stainless steel removable screen. Cast iron body, flanged ends, with bolted cap, 25mm minimum blowdown valve to 150mm (6").



## **2.5 TRAP PRIMERS**

- .1 TP:
  - .1 Electronic trap priming assembly with enclosure. Trap primer to be complete with air gap, water hammer arrester, solenoid valve, manual override switch, electronic controller and brass/copper distribution unit where required. Assembly to be installed in a 1.6129mm (16 gauge) steel cabinet with access door. Electrical requirements are 115/1/60.

## **2.6 VACUUM BREAKERS**

- .1 Atmospheric vacuum breaker: To CAN/CSA B64.

## **2.7 VALVES**

- .1 Gate Valves:
  - .1 Soldered/screwed:
    - .1 Rising stem: to MSS SP 80, Class 125, 860 kPa (125 psi), bronze body, screw in bonnet, solid wedge disc.
  - .2 Flanged:
    - .1 Rising Stem: to MS SP-70, Class 125, 860 kPa (125 psi), full faced, flanged ends, cast-iron body, bronze trim.
- .2 Globe Valves:
  - .1 Soldered/screwed:
    - .1 To MSS SP 80, Class 125, 860 kPa (125 psi), bronze body, renewable composition disc, screwed over bonnet.
    - .2 Lockshield handles: as indicated.
- .3 Swing Check Valves:
  - .1 Soldered/screwed:
    - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.
  - .2 Flanged:
    - .1 To MSS SP-71, Class 125, 860 kPa (125 psi), cast iron body, full faced, flanged ends, regrind/removable seat, bronze disc, bolted cap.
- .4 Ball Valves:
  - .1 Soldered/screwed:
    - Class 150, Bronze body, chrome plated brass, stainless steel, ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon, Buna N seat, steel lever handle.
- .5 Pressure Regulating Valves:
  - .1 63mm and under (2-1/2" and under) bronze bodies, screwed: to ASTM B62, 860 kPa (125 psi), complete with thermal bypass and strainer.
  - .2 75mm and over (3" and over): semi steel bodies, Class 125, flanged: to ASTM A 126, Class B, complete with strainer.
- .6 Balancing Valves:
  - .1 Water flow indicating device for hot water recirculation lines up to 75mm (3") shall be bi-directional, blow-out resistant, tight shutoff, ball design, with position

indicator, memory device, checked metering ports with drip caps and integral drain ports.

**2.8 WATER HAMMER ARRESTERS**

- .1 Stainless steel construction, bellows type ASSE 1010-2004.

**2.9 WATER METERS**

- .1 To AWWA and NSF 61 standards and certifications.
- .2 Bronze body construction, remote reader, sized to handle flow rates indicated.
- .3 Provide strainer on inlet prior to meter.
- .4 Low flow accuracy min. 95%.
- .5 Provide remote reader

**2.10 DOMESTIC WATER EXPANSION TANKS**

- .1 16 gauge cold rolled steel complete with appliance-quality paint for indoor or outdoor installation, welded steel connection, air valve with brass valve with o-ring seal. Top chamber is 100% butyl rubber; lower water chamber to be copolymer polypropylene. Factory pre-charged to 276kPa (40psig). Certified to NSF Standard 61 Cold.
- .2 Maximum working pressure 1035kPa (150psig).
- .3 Maximum working temperature 93.3°C (200°F).
- .4 Domestic Water Expansion tank sizing to be as per drawings:

**2.11 MIXING VALVES**

- .1 Thermostatic Water Mixing Valve with 3.8 L/min (1gpm) minimum flow capacity
- .2 3/4" (19mm) inlets, 3/4" (19mm) outlet
- .3 Integral combination check stops less wall support
- .4 8862 kPa (125 psi) maximum operating pressure
- .5 Copper encapsulated thermostatic assembly with Teflon coated stainless steel shuttle
- .6 Locking temperature regulating handle
- .7 Temperature adjustment range, 32-60°C (90-140°F)
- .8 Internal parts of stainless steel
- .9 Rough Bronze Finish
- .10 Inlet Thermometers
- .11 ASSE 1017 and CUPC Certified

- .12 4 psi (28 kPa) pressure drop at 5 gpm (19 L/min) flow rate

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

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

### **3.2 BACKFLOW PREVENTERS**

- .1 Install in accordance with CSA B64.10, where indicated and elsewhere as required by code for proper functioning of equipment and/or systems.
- .2 Pipe discharge to over nearest drain or service sink.

### **3.3 CLEANOUTS**

- .1 In addition to those required by code, and as indicated, install at base of all soil and waste stacks, and rainwater leaders and where indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum 100mm (4").

### **3.4 FLOOR DRAINS**

- .1 Ensure all floor drains are covered and protected during construction.
- .2 Verify operation of trap seal primer.
- .3 Check security, accessibility, removability of strainer.
- .4 Clean out baskets.

### **3.5 STRAINERS**

- .1 Install with sufficient room to remove basket.

### **3.6 TRAP SEAL PRIMERS**

- .1 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space and pipe to floor drain.

### **3.7 VACUUM BREAKERS**

- .1 Simulate reverse flow and back pressure conditions to test operation of vacuum breakers.

### **3.8 VALVES**

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

**3.9 WATER HAMMER ARRESTERS**

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

**3.10 WATER METERS**

- .1 Install water meters to codes.
- .2 Install water meter as indicated.
- .3 Contractor to provide all water meters.

**3.11 DOMESTIC WATER EXPANSION TANKS**

- .1 All expansion tanks to be supported with suitable hangers or pipe stands as required according to the size of the tank.
- .2 Precharge tank with suitable pressure to meet system requirements.
- .3 Drains to discharge to floor.

**3.12 MIXING VALVES**

- .1 Mount valves securely above ceiling unless indicated otherwise.
- .2 Ensure valves are accessible.

**3.13 COMMISSIONING**

- .1 Building Commissioning is a requirement of this project in order to comply with sections of Division 01 – General Requirements. A Commissioning Agent has been engaged and will provide all systems commissioning in conjunction with all trade contractors. The Commission Agent will provide a Commissioning Plan with commissioning start-up and test procedure sheets to be performed and completed by the various trade contractors.
- .2 After start up, test, adjust and prove operation as indicated, to suit site conditions such as:
  - .1 Clean out strainers periodically until clear.
  - .2 Clean out and prime all floor drain traps using trap seal primers or other means acceptable to the National Plumbing Code of Canada.
  - .3 Prove freedom of movement of cleanouts.
  - .4 Confirm proper operation of backflow preventers, vacuum breakers and trap primers.

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 22 05 00 – Common Work Results for Plumbing
- .2 Section 22 11 17 - Domestic Water Piping - Plastic
- .3 Section 22 13 16 – Sanitary Waste and Vent – Cast Iron and Copper.
- .4 Section 22 13 17 – Sanitary Waste and Vent - Plastic.
- .5 Section 22 33 00 – Domestic Water Heaters.
- .6 Section 22 42 01 – Plumbing Specialties and Accessories.
- .7 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
- .8 Section 23 05 53 – Mechanical Identification.
- .9 Section 23 07 19 – HVAC Piping Insulation.

**1.2 REFERENCE STANDARDS**

- .1 Authorities Having Jurisdiction:
  - .1 Conform to the requirements of the Authority Having Jurisdiction.
- .2 CSA Z317.1-16 - Special Requirements for Plumbing Installations in Health Care Facilities.
- .3 CAN/CSA Z317.13-17 - Infection Control During Construction, Renovation and Maintenance of Health Care Facilities.
- .4 CAN/CSA B45 Series 02 (R2013) - CSA Standards on Plumbing Fixtures.
- .5 CAN/CA B125.3-12 - Plumbing Fittings.
- .6 National Building Code of Canada (NBCC) 2015 - including all revisions and errata.
- .7 National Fire Code of Canada (NFCC) 2015 - including all revisions and errata.
- .8 National Plumbing Code of Canada (NPCC) 2015 - including all revisions and errata.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit close out documentation in accordance with in accordance with 01 11 00 – General Requirements and Section 22 05 00 – Common Work Results for Plumbing.

## **1.5 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 11 00 – General Requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Plumbing fixtures to be in accordance with CAN/CSA-B45 Series.
- .2 Plumbing fittings to be in accordance with CAN/CSA B125.
- .3 Architectural drawings to govern in determination of number and location of fixtures.
- .4 Exposed plumbing brass to be chrome plated.
- .5 Faucets shall have cold water opening clockwise and hot water counter clockwise.
- .6 Fixture stops shall be IPS threaded not soldered or braided flexible.

### **2.2 MANUFACTURED ITEMS**

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with 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.
- .7 The following manufacturers may be accepted provided the products meet or exceed the listed performance.

American Standard	Haws	Speakman
Bradley	Kindred Commercial	Stern Williams
Chicago Faucet	Powers	Kohler
Symmons	Crane	Lawler
T&S Brass	Delta Commercial	Moen
Toto	Fiat	Moen Commercial
Zurn	Gerber	Novanni
Leonard	Guardian	Sloan

### **2.3 PLUMBING FIXTURES AND TRIM**

- .1 As specified on the drawings.

**PART 3 EXECUTION**

**3.1 FIXTURE INSTALLATION**

- .1 Connect fixtures complete with chrome plated supplies and escutcheons, drains, trapped, supported level and square. Fixtures on outside walls to have supplies from wall adjacent to fixture, other fixtures to be served from wall. Wall hung fixtures to be securely mounted.
- .2 Mounting heights for wall hung fixtures and showers measures from finished floor:
  - .1 Standard: to comply with manufacturer's roughing-in details unless otherwise indicated or specified by the Consultant.
  - .2 Barrier Free: to comply with the National Building Code of Canada.
  - .3 Provide silicone sealant between all plumbing fixtures and finished walls/floors, colour to match fixture.
- .3 Fixture stops shall be IPS threaded not soldered or braided flexible.
- .4 Each fixture shall have shut-off valve and union connections on supplies. 5/8" compression valves are not to be used as isolation valves for fixtures, use soldered or screwed connections.
- .5 Hot water faucets shall be on left. Mixing faucets shall have opposite action and pressure balanced mixing valves shall have check valves on supplies.
- .6 Exposed piping, valves and metal to vitreous china fixtures shall be chrome plated with plated escutcheons.
- .7 Exposed piping, valves and metal to stainless steel fixtures shall be spray painted chrome, if not chrome plated.
- .8 Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface.

**3.2 COMMISSIONING**

- .1 Clean aerator screens and strainers.
- .2 Regulate timing on electronic and metering faucets.
- .3 Adjust flush valves as necessary for proper operation.

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 01 11 00 - General Requirements
- .2 Section 09 91 00 - Painting.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

**1.2 EQUIPMENT LIST**

- .1 Complete list of equipment and materials to be used on this project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.
- .2 Submit for approval at time of tender within 10 days after award of contract.

**1.3 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 Heating and Cooling Systems
  - .2 Ventilation Systems
  - .3 Controls

**1.4 PROTECTION OF OPENINGS**

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

**1.5 PAINTING**

- .1 To Section 09 91 00 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

**1.6 SPARE PARTS**

- .1 Furnish spare parts in accordance with Section 01 11 00 - General Requirements and 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.
  - .6 One set spare belts for each belt drive.



- .7 One pressure gauge of each type.
- .8 One thermometer of each type.
- .2 Departmental Representative to sign for spare parts.

#### **1.7 SPECIAL TOOLS**

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 11 00 - General Requirements.
- .2 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

#### **1.8 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS**

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Where specified elsewhere in Mechanical Sections, manufacturers to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Departmental Representative may record these demonstrations on video tape for future reference.

#### **1.9 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 11 00 - General Requirements.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Departmental Representative before final inspection.
- .3 Operation data to include:
  - .1 Control schematics for each system including environmental controls.
  - .2 Description of each system and its controls.
  - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
  - .4 Operation instruction for each system and each component.
  - .5 Description of actions to be taken in event of equipment failure.
  - .6 Valves schedule and flow diagram.
  - .7 Colour coding chart.
- .4 Maintenance data shall include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.

- .5 Performance data to include:
  - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified elsewhere.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

#### **1.10 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 - General Requirements.
- .2 Shop drawings and product data shall show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances. eg. access door swing spaces.
- .3 Shop drawings and product data shall be accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify as to current model production.
  - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 11 00 - General Requirements: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 List of Requested Shop Drawings:
  - .1 Pipe hangers and supports.
  - .2 Each type of thermometer and pressure gauge
  - .3 Thermal insulation for piping, ductwork, refrigeration pipe and equipment.
  - .4 Plumbing specialists.
  - .5 Plumbing fixtures and trim (all products).
  - .6 Domestic water heaters and hook up details.
  - .7 Refrigeration connecting materials, valves, sight glass and filters drier.
  - .8 Air-to-air Heat Pumps and fan coils.
  - .9 Valves and fittings: plumbing.
  - .10 Flexible duct sample.
  - .11 Fans (each type).

- .12 ERV
- .13 Access doors: wall, ceiling and duct.
- .14 Dampers: volume, fire, automatic, and control.
- .15 Louvers, grilles and diffusers.
- .16 System controls and components.
- .17 Fire Extinguishers.
- .18 Vibration Isolation.

#### **1.11 CLEANING**

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

#### **1.12 AS-BUILT DRAWINGS**

- .1 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark there on all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.
  - .4 TAB to be performed using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .3 Submit copies of as-built drawings for inclusion in final TAB report.

#### **1.13 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 - General Requirements.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.

- .4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
- .5 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .6 Dispose of corrugated cardboard, polystyrene and/or plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

#### **1.14 BREAKDOWN OF COSTS**

- .1 Refer to Section Tender Form.
- .2 Contract breakdown will be broken down by systems and by labour and material.
- .3 Submit prior to first monthly billing. Format to be approved by Departmental Representative.

#### **1.15 AS INDICATED**

- .1 Means that the item or items specified are shown on the drawings.
- .2 The word "provide" shall mean "Supply and Install".

#### **1.16 EQUIPMENT REQUIREMENTS AND INSTALLATION**

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.
- .2 Provide accessible means for lubricating equipment including permanent lubricated bearings.
- .3 Pipe all drain lines to floor drains.
- .4 Equipment, cleanouts, floor drains and like equipment shall be on the axis of the building.

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

- .1 Supply anchor bolts.
- .2 Drill and grout anchor bolts using templates.
- .3 Installed anchors shall perform to criteria required.

#### **1.18 PROTECTION OF OPENINGS**

- .1 Protect equipment and systems' openings from dirt, dust and other foreign materials during trial usage until accepted by the Departmental Representative. Provide plastic shut wrap over open ducts at end of each day.
- .2 Clean and refurbish all equipment and leave in first class operating condition including replacement of all filters as approved by the Departmental Representative.

**1.19 ELECTRICAL**

- .1 All control wiring shall be by Division 23 – Heating Ventilation and Air Conditioning (HVAC) sections unless noted otherwise. The Division 26 - Electrical contractor will leave spare 120 volt circuits in each electrical panel for the Division 23 – Heating Ventilation and Air Conditioning (HVAC) trades to use for power source for control wiring to sensors, and actuators. The Division 23 – Heating Ventilation and Air Conditioning (HVAC) trades shall install controls wiring to the standards set out in Division 26 - Electrical wiring specs.
- .2 Coordinate with Division 26 - Electrical to ensure that all controlled equipment is correctly connected for operation in accordance with plans and specifications, including supplying all necessary electrical interconnection information and location to Division 26 - Electrical.

**1.20 MOTORS**

- .1 Provide all motors for mechanical equipment as specified. All motors shall be high efficiency type.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install a motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 All motors shall be 1750 rpm unless noted otherwise.
- .4 Motors under ½ HP continuous duty built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.
- .5 Motors ½ HP and Larger: EEMAC Class B, squirrel cage induction, continuous duty, drip proof, ball bearings, three phase, 575V unless noted otherwise.
- .6 Where equipment is provided with variable speed drives, electrical motors shall be suitable for the application.
- .7 Motors 30 HP or larger or a motor requiring 10 seconds or longer to reach the full speed shall be provided with thermistor protection.

**1.21 BELT DRIVES**

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts on unit to be matched set.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys.
- .3 For motors up to 10 HP: use standard adjustment pitch drive sheaves, having ± 10% range. Use mid-position of range for specified rpm.
- .4 For motor over 10 HP: use sheave with split tapered busing and keyway having fixed pitch unless specifically required for item concerned. Provide additional sheaves and belts of correct size to suit balancing where required.
- .5 Use minimum drive rating of 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on all prime move shafts.
- .6 Motor slide rail adjustment plates to allow for center line adjustment.
- .7 Tension belts to manufacturer's recommendations before start-up and after first (100) hours of operation using calibrated belt tensioning gauge. Submit report showing the recommended and actual tension on all units.

- .8 Provide additional sheaves and belts as required for air balancing.
- .9 Fans provided with variable speed controllers shall be balanced at the lowest motor RPM achievable with the specified motor. In general, the fans shall be balanced with motors operating at 70% speed for supply fans and 90% speed for exhaust and return fans. Speeds for supply fans with clean air filters at the time of air balancing may be even lower than as stated above. Provide additional sheaves and belts to achieve the above stated requirement.

## **1.22 GUARDS**

- .1 Provide guards for drives including all fans.
- .2 Meet all the safety standards of Provincial Department of Labour and local authorities having jurisdiction.
- .3 Guards for drives shall have:
  - .1 Expanded metal screen welded to 25mm steel angle frame.
  - .2 18 ga. thick galvanized sheet metal tops and bottoms.
  - .3 Removable sides for servicing.
  - .4 38mm diameter hole on shaft centres for insertion of tachometer.
- .4 Provide means to permit lubrication and use of test instruments with guards in place.
- .5 Install belt guards to permit movement of motors for adjusting belt tension.
- .6 For flexible couplings, provide removable, "U"-shaped, 16 ga. thick galvanized mild steel guards.
- .7 Provide 19mm galvanized expanded metal screen on all unprotected fan inlets and outlets. Net free area of the guard to be not less than 80% fan openings.

## **1.23 EQUIPMENT SUPPORTS**

- .1 Equipment support products supplied by equipment manufacturers are specified with equipment elsewhere in Division 23 – Heating Ventilation and Air Conditioning (HVAC).
- .2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of Section 01 11 00 – General Requirements. All equipment supports provided by Division 23 – Heating Ventilation and Air Conditioning (HVAC) shall be prime painted.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads a minimum of 100mm high and 75mm larger than the equipment dimensions all around. Housekeeping pads to be provided by others. This trade contractor to provide drawing showing locations and sizes of housekeeping pads.
- .4 Submit shop drawings for all fabricated supports and bases. Shop drawings to include loads of the equipment to be supported, capacity of the supports and bases and design deflection. Indicate the weight of the equipment at each point of support in the shop drawings.

## **1.24 SLEEVES**

- .1 Provide pipe sleeves at all points where pipes pass through masonry or concrete walls or slabs.
- .2 Refer to Item 3 Cutting and Patching in this Section.
- .3 Sleeves to be prime coated prior to installation.
- .4 Sizes:
  - .1 Provide 12mm clearance all around between sleeve and pipes or between sleeve and insulation. Clearance around pipes penetrating fire rated walls and floors to be as required for fire stopping.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and all finished areas; and 50mm above floors in mechanical rooms and service spaces.
- .6 Fill voids around pipes.
  - .1 Refer to paragraph 28 Penetration of Walls and Floor Slabs.
  - .2 Refer to Section 07 84 00, Firestopping.
- .7 Temporarily plug all openings during construction.
- .8 Provide sleeves in all cut or drilled openings in mechanical room floors. Sleeves to be schedule 40 steel pipe. Sleeve to terminate 50mm above floor. Seal the space between the sleeve and slab opening and make it water tight.

## **1.25 ESCUTCHEONS AND PLATES**

- .1 Provide on all pipes passing through finished walls, partitions, floors and ceilings.
- .2 Use chrome or nickel plated brass, split type with set screws for ceiling or wall mounting. Acceptable Material: Crane No. 13-B-C and Grinnell Fig. 2 for copper pipe and Crane Fig. 13 for steel pipe.
- .3 Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.
- .4 Secure to pipe or finished surface but not to insulation.
- .5 Where sleeves extend above finished floor, escutcheons or plates shall cover sleeve extension.

## **1.26 TESTS**

- .1 Provide the following supplementary requirements to tests specified in mechanical work sections:
  - .1 Give written two-day notice of date when tests will be made.
  - .2 Do not insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.
  - .3 Conduct tests in presence of the Departmental Representative. Re-test if test fails.
  - .4 Bear all costs including re-testing and making good.
  - .5 Pipe Pressure:

- .1 Hydraulically test water supply systems at 1-1/2 times system operating pressure or minimum 125 psi, whichever is greater.
- .2 Test sprinkler piping to NFPA-13.
- .3 Maintain test pressures without loss for four (4) hours, unless otherwise specified.
- .4 Test all drainage, waste and vent piping to National Plumbing Code and authorities having jurisdiction.
- .5 Test all underground drainage pipe to 3m head of water for 2 hours.
- .6 Conduct all other tests as specified in other Sections of Division 23 – Heating Ventilation and Air Conditioning (HVAC).
- .7 Replace defective material or equipment and repair joints using new material.
- .8 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.
- .9 Compile all completed test reports upon completion of all tests in a 3-ring binder and submit to the Departmental Representative.

#### **1.27 PAINTING**

- .1 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated equipment.
- .2 Prime and touch-up all damaged paint on the equipment. Touch-up to match original paint. Do not paint over nameplates.
- .3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched-up.

#### **1.28 ACCESS DOORS**

- .1 Supply access doors for furred ceilings and duct shafts or spaces for servicing equipment and accessories or for inspection of safety, operating or fire devices for installation under section erecting the walls or ceilings. Also supply and arrange for installation of access pits and covers for servicing and inspection of valves, devices which are to be installed below grade or below floor in floor slabs.
- .2 Access doors shall be flush mounted 600mm x 600mm for body entry and 300mm x 300mm for hand entry, unless otherwise noted. Doors shall open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Doors shall be of approved manufacturer with published literature. Access doors shall be minimum 14 ga. thick.
  - .1 General: Prime coated steel.
  - .2 Special areas such as tiled or marble surfaces: stainless steel.
- .3 In visible areas, access door locations to be approved by the Departmental Representative prior to installation.

#### **1.29 DIELECTRIC COUPLINGS**

- .1 Provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes 50mm and under, and flanges for pipe sizes over 50mm.
- .3 Provide felt or rubber gaskets to prevent dissimilar metals contact.



- .4 Cast brass adapters may be used where approved by the Departmental Representative.

### **1.30 DRAIN VALVES**

- .1 Locate at all low points and section isolating valves unless otherwise specified.
- .2 Minimum 75mm unless otherwise specified: Straight pattern bronze with hose end male thread and complete with cap and chain.

### **1.31 INSTRUCTION OF OPERATING STAFF**

- .1 Provide certified personnel to instruct operating staff on maintenance. Provide maintenance specialist personnel to instruct operations staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.
- .2 Provide instruction during regular work hours prior to acceptance.
- .3 Use operation and maintenance data manuals for instruction purposes. On completion of instruction turn the manuals over to the Departmental Representative.
- .4 Instructions in maintenance and operation of the following equipment shall be given by factory trained personnel and for a period of two (2) working days for each of the following systems:
  - .1 Heating Systems.
  - .2 Ventilation Systems.
  - .3 Plumbing Systems.
  - .4 Fire Protection Systems.
  - .5 Chilled Water System.

The time specified above does not include the time for start-up of systems and equipment. Operating instructions for systems not listed above shall be for a period of one day. All operating instructions shall take place prior to acceptance and turnover. Where more detailed instructions for some equipment or systems are called for in other sections of the specifications, those sections of specifications shall take precedence over this section.

- .5 Training period for the Energy Management and Control Systems: 4 hours

### **1.32 CLEANING AND FINAL ADJUSTMENT**

- .1 Keep all mechanical systems and equipment clean.
- .2 Clean interior and exterior of all systems including strainers, and vacuuming of interior of ductwork and air handling units.
- .3 Clean and refurbish all equipment and leave in first class operating condition including replacement of all filters in all air and piping systems.
- .4 Balance and adjust all systems and each piece of equipment to operate efficiently.

### **1.33 PENETRATION OF WALLS AND FLOOR SLABS**

- .1 Wherever pipes and ducts penetrate non-fire rated walls and floor slabs, tightly pack the space between construction and ducts/pipes the full depth with acoustic filler material and seal both sides with acoustic sealant. Where pipes pass through fire rated walls and floor

slabs, pack space between the pipe and sleeve with approved fire rated and ULC approved sealant.

- .2 Acoustic Filler:
  - .1 Filler material shall be glass fibre or inorganic mineral.
  - .2 Filler material shall not have higher combustion rating than the following:
    - Flame Spread Rating = 25
    - Smoke Development Rating = 0
    - Fuel Contribution Rating = 0
- .3 Acoustic Sealant:
  - .1 Concealed Application:
    - .1 Non-shrinking, non-straining, non-drying and permanently elastic type.
  - .2 Exposed Application:
    - .1 Permanently elastic, paintable acoustic sealant, latex acrylic or acrylic latex type.

#### **1.34 PREPARATION FOR FIRE STOPPING**

- .1 Firestopping material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to be ULC listed and acceptable to the Provincial Fire Marshall's Office. Installation to be as per manufacturer's recommendations and ULC's testing procedure and 07 84 00 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 to move without damaging firestopping material.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barrier at fire separation.
- .5 Refer also to Section 07 84 00- Firestopping. Division 23 – Heating Ventilation and Air Conditioning (HVAC) is responsible for providing firestopping for all mechanical duct, pipe and wiring penetrations of fire rated partitions. Work to be done to the standards defined in Section 07 84 00 - Firestopping. Intent is to ensure the Mechanical Trades are responsible for their own fire stopping. The wiring fire stopping is only that done by the Div 23 contractor or his sub-contractors (Control wiring, etc.); it is not intended to include for Electrical work.

#### **1.35 SITE SERVICES**

- .1 Known Services:
  - .1 Conform to drawings, they represent known existing underground facilities.
  - .2 Discuss with the Departmental Representative before starting work and follow his written instructions.
  - .3 Once location is set out, be responsible for all damage there to during excavation work and for the cost of all repairs and replacements made necessary thereby.

#### **1.36 DRAWINGS**

- .1 Mechanical drawings are not intended to show structural details or architectural features.
- .2 **The Mechanical drawings are not to be scaled.**
- .3 Except where dimensioned, mechanical drawings indicate general Mechanical layouts only. Because of the small scale of Mechanical drawings, it is not possible to show all offsets, fittings and accessories which may be required. Investigate structural and finish

conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories which are required to meet the conditions.

### **1.37 EXISTING SITE CONDITIONS**

- .1 The Trade-Contractor shall visit the site of the building in order to examine first hand the existing conditions which may affect his contract. No compensation shall be considered for additional expenditures incurred later through failure to do so.

### **1.38 CUTTING AND PATCHING**

- .1 Any cutting, coring and patching shall be done by the Trade-Contractor required for Division 21 – Fire Suppression, Division 22 - Plumbing or Division 23 – Heating Ventilation and Air Conditioning (HVAC) work. Any cutting, coring and patching required for Division 21 – Fire Suppression, Division 22 - Plumbing or Division 23 – Heating Ventilation and Air Conditioning (HVAC) work shall be the responsibility of Division 21 – Fire Suppression, Division 22 - Plumbing or Division 23 – Heating Ventilation and Air Conditioning (HVAC).
- .2 Holes in slabs shall be by coring and the responsibility of Trade concerned. Locations to be approved by the Departmental Representative.
- .3 If the location proposed by the Trade-Contractor is rejected by the Departmental Representative, the Departmental Representative and Trade Contractor will meet on site to determine a mutually agreeable location.

### **1.39 PROTECTION OF DUCTWORK DURING CONSTRUCTION**

- .1 The interior of all ductwork shall be protected from construction dust and dirt by sealing all open ends of the ducts.

### **1.40 INSTALLATION OF CONTROL INSTRUMENTS AND DEVICES**

- .1 All control valves and dampers shall be supplied and installed by the respective Sections of Division 23 – Heating Ventilation and Air Conditioning (HVAC).
- .2 Division 21 – Fire Suppression & Division 23 – Heating Ventilation and Air Conditioning (HVAC) shall install wells for all control instrumentation and devices installed in piping.
- .3 Division 23 – Heating Ventilation and Air Conditioning (HVAC) shall provide access doors in ductwork for all control instrumentation and devices installed in ductwork.

### **1.41 COMMISSIONING**

- .1 Building Commissioning is a requirement of this project in order to comply with sections of Division 01 – General Requirements.
- .2 All the major mechanical systems shall be commissioned. Brief description of the commissioning process is as below:
  - .1 All supply, return and exhaust air systems shall be verified for operation and capacity, and controllability over capacity range.
  - .2 The new heating and cooling heat pump system shall be verified for operation and capacity.
  - .4 Operation of all terminal units will be verified.
  - .5 Domestic Hot Water Systems and recirculation pump.
  - .7 All energy management and control systems shall be verified for operation.

- .3 The commissioning process will be lead by the Departmental Representative. The Mechanical Trade Contractor shall ensure that his Project Manager, TAB and EMCS are present to assist during commissioning. The responsibilities of the Mechanical Trade Contractor's representative and his sub-contractors are defined below:
  - .1 Mechanical Trade Contractor shall be responsible for operation of the Mechanical Systems during commissioning.
  - .2 TAB shall assist with measurements of flows, temperatures, air velocities, etc.
  - .3 EMCS technicians shall be responsible for starting/stopping the equipment, to make adjustments to EMCS routines and to provide any other EMCS generated data required for commissioning.

**1.42 EXCAVATION & BACKFILLING**

- .1 All excavation and backfilling for underground mechanical services shall be carried out by the General Contractor.

**1.43 DRAINS FROM HVAC EQUIPMENT & PLENUMS**

- .1 Drains from air handling units, air intake plenums, exhaust air plenums shall be trapped and run to the nearest floor drain by the Heating/HVAC Trade Contractor. Drain Sizes shall be a minimum of 38mm. Drains shall be properly trapped and sloped a minimum of 6mm per foot. Trap depth shall equal fan static plus 50mm.
- .2 All condensate piping is to be Type "L" copper.

END

**PART 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results - Mechanical

**1.2 REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1-07, Power Piping.
- .2 ASTM International (ASTM)
  - .1 ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).
- .6 Underwriter's Laboratories of Canada (ULC)

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 11 00 - General Requirements.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of New Brunswick.
  - .2 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:

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

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 11 00 - General Requirements.

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

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions Section 01 11 00 - General Requirements.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials crates, pallets, padding, in accordance with Section 01 11 00 - General Requirements.

### **PART 2 PRODUCTS**

#### **2.1 SYSTEM DESCRIPTION**

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

#### **2.2 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58. ANSI B31.1.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

#### **2.3 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized after manufacture.
  - .2 Use electro-plating galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.

- .3 Do not use 22 mm or 28 mm rod.
- .3 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel black galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .4 Adjustable clevis: material to MSS SP69 UL listed, FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .5 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .6 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated with formed portion plastic coated.
- .7 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.4 RISER CLAMPS**

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

## **2.5 INSULATION PROTECTION SHIELDS**

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

## **2.6 CONSTANT SUPPORT SPRING HANGERS**

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

## **2.7 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. 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.

## **2.8 EQUIPMENT SUPPORTS**

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

## **2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **2.10 HOUSE-KEEPING PADS**

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

## **2.11 OTHER EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports from structural grade steel.
- .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 and ventilation systems as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:



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

### 3.3 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code of Canada (NPC) or the authority having jurisdiction, whichever is more stringent.
- .2 Fire protection: to applicable fire code.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .5 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

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

### 3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### **3.5 HORIZONTAL MOVEMENT**

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

### **3.6 FINAL ADJUSTMENT**

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

### **3.7 FIELD QUALITY CONTROL**

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

### **3.8 CLEANING**

- .1 Clean in accordance with Section 01 11 00 - General Requirements.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling reuse in accordance with Section 01 11 00 - General Requirements.

END

## **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.
- .2 Related Sections
  - .1 Division 01 - General Requirements.

### **1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

### **1.3 SUBMITTALS**

- .1 Product data submittals in accordance with sections of Section 01 11 00 - General Requirements.
- .2 Product data to include paint colour chips, other products specified in this section.
- .3 Samples:
  - .1 Submit samples in accordance with sections of Section 01 11 00 - General Requirements.

### **1.4 QUALITY ASSURANCE**

- .1 Do construction occupational health and safety in accordance Section 01 11 00 - General Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with sections of Division 01 - General Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 00 General Requirements.
  - .2 Remove from site and dispose of all 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 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 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 SUSTAINABLE REQUIREMENTS**

- .1 Materials and products in accordance with sections of Division 01 - General Requirements.

### **2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES**

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

### **2.3 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 1/8" 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.

.3 On t-bar ceiling splines and at units for fire dampers, fan coils, ERV, etc. that are mounted in the ceiling space.

## 2.4 EQUIPMENT CONCEALED BY CEILING

.1 At valves, plumbing air vents and drains, dampers and other similar pieces of equipment located above T-bar ceilings or access doors, provide circular 19mm ( $\frac{3}{4}$ ") diameter self-adhesive identification discs on the underside of the ceiling, located as near as possible to where the item is located.

.2 Discs shall be coloured as scheduled in this specification.

.3 Where the item has a primary and secondary colour, provide a 19mm ( $\frac{3}{4}$ ") diameter primary colour disc with a 10mm ( $\frac{3}{8}$ ") diameter secondary colour disc centred on the primary disc.

.4 For backflow preventors, fire dampers, air terminal units, exhaust fans, reheat coils, balancing dampers and other similar pieces of equipment located above T-bar ceilings or access doors, provide laminated plastic plates as noted for System nameplates above. A second identical plate shall be installed on the underside of the ceiling grid or access door opening frame, as close as possible to the location of the equipment.

.5 Damper handles shall be spray painted a bright colour to enable Air Balance Contractor to readily locate.

## 2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

- .1 Block capital letters 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 19mm (¾") and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive plastic-coated cloth 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.  
Colours for legends, arrows: to following table:

BACKGROUND COLOUR	LEGEND, ARROWS
Yellow	Black
Green	White
Red	White

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

Pipe Marker	Legend	Background Colour
Tempered Water	Temp. Water	Yellow
Domestic Cold Water	DOM. CWS	Green
Domestic Hot Water	DOM. HW SUPPLY	Green
Dom. HWS recirculation	DOM. HW CIRC	Green
Sanitary	SAN.	Green
Plumbing Vent	SAN. VENT	Green

- .8 Valves
  - .1 50mm (2") laminated plastic plates (tags) with corner hole shall be provided for all valves and installed with nonferrous chains, "S" hooks or heavy duty plastic tie wraps. Tags shall have horizontal 12mm (1/2") letters accurately aligned and machine engraved into the core. Required for all valves and operating controllers.
  - .2 Provide one valve chart for each Operations and Maintenance Manual and one

chart framed and wall mounted.

.3 Valves in systems to be numbered consecutively.

.9 Buried Pipe Identification

.1 Use detectable Identoline underground warning tape colour coded to pipe service for full length of pipe.

.2 Bury to manufacturers recommendations.

.3 Identify all systems, equipment, components, controls and sensors. Inscription to identify function.

.10 Duct Identification

.1 50mm (2") high black stencilled letters to be used, i.e., "Fresh Air", "Supply", "Return", "Sanitary Exhaust", "Kitchen Exhaust", with directional flow arrow and Fan System No.

.2 Maximum distance between markings not to exceed 15m (50'-0").

.3 Locate identification on long straight runs in Mechanical Rooms so that at least one is clearly visible from any one viewpoint in usual operating areas or walking aisles, adjacent to all changes in direction, at least once in each room, on both sides of visible obstructions, on both sides of walls, floors and partitions, at each piece of equipment and beside each access door.

.4 Stencil over final finish only.

.5 Identify system to include air handling unit number.

.11 Controls Equipment Identification

.1 Electrically fed equipment supplied by Division 23 – Heating, Ventilation and Air Conditioning (HVAC) (excluding that noted in .2, below) shall be identified as per Division 26 - Electrical identification requirements.

.2 Intermediate and end control devices including sensors, controllers, monitoring devices, etc., shall be identified with laminated plastic plates as noted for System nameplates above. The plates shall be fastened securely with pop rivets or screws. Where rivets or screws are not feasible, provide heavy duty plastic tie wraps. As a minimum control device identification shall correspond to descriptors provided in the approved shop drawings with respect to panel designation or DDC point name.

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

**2.6 LANGUAGE**

.1 Identification in English.

**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 painting specified in sections of Division 01 - General Requirements 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, cool and/or insulated surfaces.
- .3 Protection:
  - .1 Do not paint, insulate or cover.
- .4 Nameplates to be fastened securely with pop rivets or screws in conspicuous place.

### **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 5'-6" intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.



**3.6 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 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with sections of Division 01 - General Requirements, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

**3.8 BURIED PIPE IDENTIFICATION**

- .1 Use Detectable Identoline underground warning tape colour coded to pipe service for full length of pipe.
- .2 Bury to manufacturer's recommendations.

**3.9 CLEANING**

- .1 Proceed in accordance with Section 01 11 00 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

**PART 1 GENERAL**

**1.1 GENERAL**

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.
- .2 TAB shall be carried out by an independent Agency registered member of AABC or NEBB.

**1.2 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 14 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.

**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 all other related systems under all 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.
- .3 Refer to Division 01 – General Requirements, Division 21 – Fire Suppression, Division 22 – Plumbing and Division 26 - Electrical for other requirements as included and outlined in other sections of the specifications.

**1.6 PRE-TAB PREVIEW**

- .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and all 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 all TAB devices, equipment,

accessories, measurement ports and fittings.

## **1.7 START - UP**

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

## **1.8 OPERATION OF SYSTEMS DURING TAB**

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

## **1.9 START OF TAB**

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB only when each phase of project is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weather-stripping, sealing, caulking.
  - .3 All pressure, leakage, other tests specified elsewhere.
  - .4 All provisions for TAB installed and operational.
  - .5 Start-up, verification for proper, normal and safe operation of all 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 All outlets installed, volume control dampers open.
    - .3 Liquid systems:
      - .1 Flushed, filled, vented.
      - .2 Correct pump rotation.
      - .3 Strainers in place, baskets clean.
      - .4 Isolating and balancing valves installed, open.
      - .5 Calibrated balancing valves installed, at factory settings.
      - .6 Chemical treatment systems complete, operational.

## **1.10 APPLICATION TOLERANCES**

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

**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:
  - .1 Proposed methodology and procedures for performing TAB if different from referenced standard.

**1.14 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, three (3) copies sample of rough TAB sheets. Make changes and resubmit if necessary include:
  - .1 Details of instruments used.
  - .2 Details of TAB procedures employed.
  - .3 Calculations procedures.
  - .4 Summaries.

**1.15 TAB REPORT**

- .1 Format to be in accordance with AABC, NEBB, or SMACNA.
- .2 TAB report to show all results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit one (1) PDF copy of TAB Report to Departmental Representative for verification and approval. One hard copy is to be included in the O&M Manuals after approval has been given by the Departmental Representative.

**1.16 VERIFICATION**

- .1 All reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of all 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.

**1.17 SETTINGS**

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

#### **1.18 COMPLETION OF TAB**

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

#### **1.19 AIR SYSTEMS SMACNA, ASHRAE**

- .1 Standard: TAB to be to most stringent standards of AABC, SMACNA, and ASHRAE.
- .2 General: measurements as required by referenced standards, including, but not limited to, the following:
  - .1 Measurements:
    - .1 Air velocity.
    - .2 Static pressure.
    - .3 Velocity pressure.
    - .4 Temperature:
      - .1 Wet bulb.
      - .2 Dry bulb.
    - .5 Cross sectional area.
    - .6 RPM.
    - .7 Electrical power:
      - .1 Voltage.
      - .2 Current draw.
  - .2 Location of equipment measurements:
    - .1 Inlet and outlet of each:
      - .1 Fan.
      - .2 Coil.
      - .3 Filter.
      - .4 Damper.
      - .5 Other auxiliary equipment.
  - .3 Location of system measurements at:
    - .1 Main ducts.
    - .2 Main branch ducts.
    - .3 Sub-branch ducts.
    - .4 Each supply, exhaust and return air inlet and outlet.
    - .5 Terminal Unit.
    - .6 Other auxiliary equipment.
    - .7 All areas served by system.
  - .4 All locations for systems measurements shall be identified and be readily accessible for future testing agencies.

## **1.20 HYDRONIC SYSTEMS**

- .1 General: measurements as required by referenced standards, including, but not limited to, following:
  - .1 Measurements:
    - .1 Flow.
    - .2 Pressure.
    - .3 Temperature.
    - .4 Specific gravity.
    - .5 RPM.
    - .6 Electrical power:
      - 1. Voltage.
      - 2. Current draw.
  - .2 Location of equipment measurements:
    - .1 Inlet and outlet for each:
      - 1. Heat exchangers (primary and secondary sides).
      - 2. Heating Coils.
      - 3. Indirect Water Heaters
      - 4. Pumps.
      - 5. PRV.
      - 6. Make-up (water).
      - 7. Flow rates for each circuit setter.
  - .3 Location of system measurements at:
    - .1 Supply and return each primary and secondary loop of following hydronic systems:
      - 1. Heating Systems.
      - 2. Glycol Systems.
      - 3. Pool Water System.
      - 4. Consider glycol systems as hydronic for purposes of this section.

## **1.21 DOMESTIC HW SYSTEM**

- .1 Meet all requirements as specified for hydronic systems.
- .2 Locations of equipment measurements: To include, but not limited to, following as appropriate: circulator, at each balancing valve.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

## **1.22 OTHER SYSTEMS**

- .1 Plumbing System:
  - .1 TAB procedures:
    - .1 Refer to Division 22 – Plumbing as applicable.

**1.23 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to all work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified in 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 all times.
- .3 Zone pressure differences:
  - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible conditions of normal operating modes.
- .4 Provide balancing of all system and establish system supply and return static pressure readings and fan speed drive positions for all modes of system operation.

**1.24 POST OCCUPANCY TAB**

- .1 Emergency evacuation: Participate in full scale emergency evacuation exercises.
- .2 Participate in systems checks twice during the one year standard Warranty Period - #1 check approximately three (3) months after acceptance and #2 check within one month of termination of Warranty Period.

**1.25 SCHEDULING OF AIR BALANCING**

- .1 The final air balancing report must be submitted a minimum of three (3) weeks before the substantial completion date.

**1.26 IDENTIFICATION OF DUCT TRAVERSE LOCATIONS**

- .1 Locations where duct traverses are taken shall be marked and identified on the ductwork and the ceilings to enable the location of existing holes in the ductwork for future airflow measurements.

END

## **PART 1 GENERAL**

### **1.1 RELATED SECTIONS**

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

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
  - .1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM):
  - .1 ASTM B209M-02, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  - .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795-92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .9 ASTM C921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Canadian General Standards Board (CGSB):
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .5 Underwriters Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-01, Thermal Insulation Polystyrene, Boards and Pipe Covering.

### **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: Code Round Ductwork.
  - .2 CRF: Code Rectangular Finish.

#### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with sections of Section 01 11 00 - General Requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

#### **1.5 MANUFACTURER'S INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with sections of Section 01 11 00 General Requirements.
- .2 Installation instructions to include procedures used, and installation standards achieved.

#### **1.6 QUALIFICATIONS**

- .1 Installer: specialist in performing work of this section, and have demonstrated experience in this size and type of project.

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

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

#### **1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 00 - General Requirements.
- .2 Remove from site and dispose of all 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 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 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 GENERAL**

- .1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN4-S102.
- .2 Materials to be tested in accordance with ASTM C411.

### **2.2 D-1 DUCT INSULATION WITH VAPOUR BARRIER**

- .1 Application: Ductwork up to 30" for:
  - .1 All fresh air intake plenums and ducts.
  - .2 All supply air duct.
  - .3 Exhaust air ductwork from fan or damper to exhaust louvers.
  - .4 All exhaust air ductwork within 10 feet of outdoor outlet shall be insulated or until the motorized damper, whichever is further.
- .2 Material:
  - .1 CGSB 51-GP-11M+Amdt-Apr-78 mineral glass fibre blanket. CGSB-51-GP-52 for vapour barrier.
- .3 Thickness: Supply air ductwork: 1".  
  
Fresh air intake plenums and exhaust air ductwork: 2".

### **2.3 FASTENINGS**

- .1 Tape: self-adhesive, 4" wide, aluminum, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
- .2 Contact adhesive: quick-setting, non-flammable fire resistive to adhere fibrous glass to ducts. Flame spread 15, smoke development 0.
- .3 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.
- .4 For Canvas:
  - .1 Washable adhesive for cementing canvas lagging cloth to duct insulation.
- .5 Pins:
  - .1 Weld pins 1/6" diameter, with 1-1/2" diameter head for installation through the insulation. Length to suit thickness of insulation.
  - .2 Weld pins 1/12" diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 1-1/4" square.
  - .4 Acceptable Manufacturer:
    - Duro Dyne spotter pins with spotter clips or stop clips as required.

### **2.4 JACKETS**

- .1 Canvas:
  - .1 Apply in exposed areas: ULC listed plain weave, cotton fabric at 11 oz/ft2.

## **2.5 ACOUSTIC LAGGING FOR DUCTS**

- .1 Product shall consist of a clear, tough polyester cover, a bonded flexible 1-6 lb. per sq. ft. banner for transmission loss and a 0.25in. urethane foam decoupler.

## **PART 3 EXECUTION**

### **3.1 APPLICATION**

- .1 Apply insulation after required tests have been completed and approved by Engineer. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes to manufacturer's recommendations and as specified.
- .2 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves and supports.
- .3 Use stand-offs for all duct mounted control accessories.
- .4 Apply 20 ga. thick galvanized sheet metal corners to all ductwork in mechanical rooms.

### **3.2 INSTALLATION**

- .1 General:
  - .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
  - .2 Adhere and seal vapour barrier using vapour seal adhesives.
  - .3 Stagger longitudinal and horizontal joints, on multi-layered insulation.
- .2 Mechanical fastenings:
  - .1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 8" centres, but not less than 2 rows per side and bottom.
- .3 Acoustic Lagging for Ducts:
  - .1 Install in strict accordance with manufacturer's instructions using manufacturer specified adhesives.

### **3.3 SIZING**

- .1 Provide fire retardant coating on canvas jackets.
- .2 Fire retardant coating shall be U.L. approved.
- .3 Coat canvas covering exposed in finished spaces with diluted coat of lagging adhesive. Provide two coats of lagging adhesive. Dilution of lagging adhesive as per manufacturer's recommendations for painting.

### **3.4 INSULATION TABLE**

- .1 As per Table below:

DUCT INSULATION TABLE		
Service	Insulation	Thickness
Exhaust from Damper/Fan to Outside	D1	25 mm
ERV Supply Air after electric heating coil	-	-
ERV Fresh Air Intake/Supply sir to EHC	D1	25 mm
ERV Exhaust Air	D1	25 mm
ERV return Air	-	-
Air Intake Plenums	D1	50 mm
Exhaust Air Plenums	D1	50 mm

### 3.5 COMMISSIONING

- .1 Building Commissioning as per Division 01.

END

## **PART 1        GENERAL**

### **1.1        SUMMARY**

- .1    Section Includes:
  - .1    Thermal insulation for piping and piping accessories in commercial type applications.
- .2    Related Sections:
  - .1    Division 01 - General Requirements.

### **1.2        REFERENCES**

- .1    American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
  - .1    ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2    American Society for Testing and Materials International (ASTM):
  - .1    ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
  - .2    ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3    ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4    ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5    ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
  - .6    ASTM C547-2003, Mineral Fiber Pipe Insulation.
  - .7    ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .8    ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3    Canadian General Standards Board (CGSB):
  - .1    CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2    CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4    Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1    Material Safety Data Sheets (MSDS).
- .5    Manufacturer's Trade Associations:
  - .1    Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .6    Underwriters' Laboratories of Canada (ULC):
  - .1    CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2    CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

- .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings.
- .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

### 1.3 DEFINITIONS

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

### 1.4 SUBMITTALS

- .1 Submittals: in accordance with sections of Section 01 11 00 – General Requirements.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with sections of Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
    - .1 Submit 12 copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with sections of Section 01 11 00 – General Requirements.
- .4 Quality Assurance Submittals: submit following in accordance with sections of Division 01 - General Requirements.
  - .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 Contractor will make available five (5) copies of systems supplier's installation instructions.

### 1.5 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Installer: specialist in performing work of this Section and have demonstrated experience in this size and type of project, qualified to standards of TIAC.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

### 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and sections of Division 01 - General Requirements.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 00 – General Requirements
  - .2 Remove from site and dispose of all 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 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
  - .6 Fold up metal banding, flatten and place in designated area for recycling.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all 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 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 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 GENERAL**

- .1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN4-S102.
- .2 Materials to be tested in accordance with ASTM C411.

## **2.2 P-1 FORMED MINERAL FIBRE TO 200°C**

- .1 Application: for piping valves and fittings on:
  - .1 Domestic hot water, temperature 60°C.
- .2 Materials:
  - .1 CGSB 51-GP-9M, rigid mineral fibre sleeving for piping.
  - .2 Thickness: To NECB, refer to table.

## **2.3 P-2 FORMED MINERAL FIBRE WITH VAPOUR BARRIER TO 85°C**

- .1 Application: for piping, valves and fittings on:
  - .1 All domestic cold water, temperature 4°C.
  - .2 All other cold water piping systems such as trap priming above floors, drains from plenums.
  - .3 All fan coil unit condensate drainage piping.
- .2 Material:
  - .1 CGSB 51-GP-9M, rigid mineral fibre sleeving for piping and CGSB 51-GP-52M, vapour barrier jacket and facing material.
  - .2 Thickness: To NECB.
  - .3 Thickness: To NECB 2015, refer to table.
  - .4 Thickness for all rainwater piping, heat traced sprinkler piping, heat traced sanitary piping and all fan coil unit condensate piping to be 1".

## **2.4 ELASTOMERIC INSULATION WITH VAPOR BARRIER -40°C TO 105°C (-40°F TO 220°F)**

- .1 Application: All refrigerant piping and fittings.
- .2 Material:
  - .1 ASTM C534/C534M-16-Standard Specification for Preferred Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .3 Thickness:
  - .1 25mm (1") for refrigerant piping.

## **2.5 FASTENINGS**

- .1 For insulation systems P-1, P-2:
  - .1 Tape: self adhesive aluminum ULC labelled for less than 25 flame spread and less than 50 smoke developed.
  - .2 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.
  - .3 Lagging adhesive: fire retardant coating.
- .2 For vapour barriers:
  - .1 Quick-setting adhesive for joints and lap sealing of vapour barriers. Flame spread 10, smoke development 0.
- .3 All adhesives shall be U.L. listed and suitable for application as per insulation manufacturers' recommendations.



## **2.6 INSULATION CEMENT**

- .1 To CAN/CGSB-51.12.

## **2.7 JACKETS**

- .1 Canvas:
  - .1 Apply in exposed areas: ULC listed plain weave, cotton fabric at 11 oz/ft<sup>2</sup>.
  - .2 On concealed valves and fittings: ULC listed plain weave cotton fabric at 11 oz/ft<sup>2</sup>.
- .2 PVC:
  - .1 Apply in exposed areas accordance with CGSB 51-GP-53M.
    - .1 15 mil thick minimum.
    - .2 Fitting covers, one piece, premoulded to match.
    - .3 Fastenings standard to manufacturer.
    - .4 PVC jacket will meet 25 flame spread and 50 smoke developed rating.
    - .5 Jacket colouring to be white.
- .3 All exterior piping:
  - .1 Waterproofed and clad in Aluminum Jacketing
  - .2 Install waterproofing as per manufacturers recommendations.
  - .3 Cover with 18 gauge aluminum jacket with cinch straps on 36" (900 mm) centres.

## **2.8 REMOVABLE PREFABRICATED INSULATION AND ENCLOSURES**

- .1 Application: expansion joints, valves, orifice plates.
- .2 Design: to permit movement of expansion joint to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
  - .1 Flexible to fit components.
  - .2 Thickness to match application.
  - .3 Chilled water systems: provide vapour barrier.
  - .4 Enclosure: aluminum 1/16" thick to match adjacent pipe jacketing.

## **PART 3 EXECUTION**

### **3.1 APPLICATION**

- .1 Apply insulation after required tests have been completed and approved by Departmental Representative Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified herein.
- .2 On piping with insulation and vapour barrier, install high density insulation under hanger shield. Maintain integrity of vapour barrier over full length of pipe without interruption at sleeves, fittings and supports.
- .3 Apply insulation materials, accessories and finished in accordance with manufacturers' recommendations.

### 3.2 INSTALLATION

- .1 Preformed: Sectional up to 300mm (12"), sectional or curved segmented above 300mm (12").
- .2 Expansion Joints in Insulation: Terminate single layer and each layer of multiple layers in straight cut at intervals recommended by manufacturer. Leave void 25mm (1") between terminations. Pack void tightly with mineral fibre.
- .3 Seal and finish exposed ends and other terminations with insulating cement.
- .4 Expansion Joints in Piping: Provide for adequate movement without damage to insulation or finishes.
- .5 Orifice Plate Mounting Flanges, Flanges & Unions at Equipment, Expansion Joints, Valves, Other Components Requiring Regular Maintenance: Install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finishes.
- .6 Insulation is not required for:
  - .1 Chrome-plated piping, valves and fittings.

### 3.3 THICKNESS

- .1 NECB Table of Minimum Pipe Insulation Thickness as follows:

Service	MINIMUM PIPE INSULATION THICKNESS MM / (")				
	Pipe Size				
	Run outs up to 50mm/(2")	Up to 25mm(1")	30 to 50mm (1-1/4" to 2")	65-100mm (2-1/2" -4")	150mm and Up (6" and Up)
Domestic Hot Water	25mm (1")	25mm (1")	38mm (1.1/2")	38mm (1.1/2")	38mm (1.1/2")
Domestic Cold Water	25mm (1")	25mm (1")	25mm (1")	25mm (1")	25mm (1")
Domestic Hot Water Recirculation	25mm (1")	25mm (1")	38mm (1.1/2")	38mm (1.1/2")	38mm (1.1/2")

- .2 Provide insulation on piping per Minimum HVAC Pipe Thickness (mm) NECB Table 5.2.5.3 or the table above, whichever is more stringent. Design temperature range for each system for insulation purposes shall be as follows:

Service	Tag	Design Temperature Range (C)
Domestic Cold Water	D.C.W.	4-16
Domestic Hot Water	D.H.W.	41-60

### 3.4 FASTENINGS

- .1 Secure pipe insulation by tape at each end and centre of each section, but not greater than 450 mm (18") on centres.

### **3.5 SIZING**

- .1 Provide fire retardant coating on canvas jackets.
- .2 Fire retardant coating shall be U.L. approved.
- .3 Coat canvas covering exposed in finished spaces with diluted coat of lagging adhesive. Provide a total of two coats of lagging adhesive. Provide a total of two coats of lagging adhesive. Dilution of lagging adhesive as per manufacturer's recommendations for priming.

### **3.6 HANGERS**

- .1 Hot Piping:
  - .1 For pipes up to 50mm (2"), provide proper covering shields sized to suit the insulated pipe, between the pipe insulation and the pipe hanger or support.
  - .2 Where roller hangers and supports are used for hot piping 50mm (2") diameter and larger, steel protection saddles shall be supplied and installed as part of the piping work. Pack the saddle voids with fiberglass insulation.
- .2 Cold Piping:
  - .1 Use calcium silicate insulation at all hanger locations on cold piping systems, except domestic water piping. Calcium silicate insulation length to be 450 mm (18"). Thickness of insulation to be the same as specified on adjacent insulation. The use of the "Buckaroo System" in lieu of the calcium silicate insulation at the hangers on cold piping will be acceptable.

### **3.7 DEMOUNTABLE INSULATION**

- .1 Insulation on valves, flanges, strainers, pumps, and other fittings requiring access for servicing shall be demountable.

### **3.8 PIPE ELBOWS**

- .1 Use of flexible insulation for pipe elbows will be acceptable.

### **3.9 REFRIGERANT PIPING**

- .1 Insulation shall fit in snug contact with pipe and be installed in accordance with Manufacturer's recommendations.
- .2 Stagger joints on layered insulation.
- .3 Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
- .4 Seal joints in insulation.
- .5 Insulate flexible pipe connectors.
- .6 Provide 150mm (6") long, 20 ga. galvanized steel sleeve around pipe insulation at each support.
- .7 Extend insulation through pipe support clamps.

- .8 Insulation shall have "slit" joint seams placed on bottom of pipe. Use manufacturer's recommended adhesive to seal joints.
- .9 Insulate fittings with sheet insulation and as recommended by manufacturer.

### **3.10 FINISHES**

- .1 Finishes:
  - .1 Exposed indoors: canvas or PVC Jacket.
  - .2 Exposed in mechanical rooms: Canvas or PVC Jacket.
  - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
  - .5 Outdoors: water-proof aluminum jacket.
  - .6 Finish attachments: aluminum bands, at 6" on centre. Seals: closed.
  - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

### **3.11 CLEANING**

- .1 Proceed in accordance with sections of Section 01 11 00 – General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

### **3.12 COMMISSIONING**

- .1 Building Commissioning as per Division 01

END

**PART 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 11 00 – General Requirements.
- .2 Section 23 05 00 – Common Work Results for Mechanical

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 11 00 – General Requirements
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 11 00 – General Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 As per Section 01 11 00 – General Requirements

**PART 2 PRODUCTS**

**2.1 REVERSE ACTING THERMOSTAT (LINE VOLTAGE)**

- .1 Line voltage, wall-mounted thermostat, for cooling with:
  - .1 Full load rating: 15 A at 120 V.
  - .2 Temperature setting range: 5 degrees C to 30 degrees C.
  - .3 Thermometer range: 5 degrees C to 30 degrees C.
  - .4 Markings in 5 degree increments.
  - .5 Differential temperature fixed at 1.1 degrees C.

**2.2 PROGRAMMABLE TIME CLOCK**

- .1 Wall mounted digital 7-day programmable time clock, complete with:
  - .1 Power: 120V
  - .2 Contacts shall be rated for 24V DC
  - .3 Unit shall have battery back—up to maintain time and date in the event of a power outage.
  - .4 Programmable for a seven day schedule
  - .5 Time clock shall be able to repeat the program on a weekly basis.
  - .6 Unit shall have a manual override

## **2.3 CONTROLS WIRING**

- .1 Electrical work shall be in accordance with the Canadian Electrical Code, NFPA 70 and ANSI C2. Electrical wiring, terminal blocks and other high voltage contacts shall be fully enclosed or properly guarded and marked to prevent accidental injury to personnel. Control wiring to be FT4 rated with yellow jacket and installed as follows:
  - .1 Cables shall be Tye—wrapped neatly and installed in accordance with CEC 60-312/16.220/12.010/2.128 and shall be FT4 rated with yellow jacket.
  - .2 The installation of "surface" wiring on walls or in open (non—enclosed) type ceilings, shall always be in EMT type conduit complete with associated "steel" type connectors and couplings.
  - .3 EMT conduits are to be extended to within 30" of all various control devices associated with the operation of any given piece of mechanical equipment or device they might feed.
  - .4 Unless specifically indicated otherwise, liquid tight flexible metal conduit complete with matching liquid tight type connectors are to be used for "final" connection between end of EMT conduit and applicable control device. A junction or pull box may also be utilized to make the transition.
  - .5 EMT type conduit "wall—stub" complete with flush installed device box shall be located in all partitions to accommodate wiring between the device and the accessible ceiling space.
  - .6 EMT connectors complete with nylon insulated throat or threaded type bushing shall be installed on the end of EMT stub where it protrudes through wall "above", and within finish accessible type ceilings. EMT plastic end cap bushings that are CSA approved may also be used.
  - .7 All EMT conduit stubs are to be "bonded" to ground as required by CEC.
- .2 All equipment provided under this section shall be installed complete with all required electric control wiring. Provide all control wiring.
- .3 Control wiring, 50 volts or more, shall be a minimum of no. 14 gauge wire. Control wiring less than 50 volts shall be a minimum of no. 18 gauge.

## **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 electric and electronic control systems installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 INSTALLATION**

- .1 Install control devices.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.

- .3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 11 00 – General Requirements
- .2 Leave Work area clean at end of each day.
- .2 Waste Management: separate waste materials for reuse and/or recycling in accordance with Section 01 11 00 – General Requirements
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END

## **PART 1        GENERAL**

### **1.1        SUMMARY**

- .1    Section Includes:
  - .1        Materials and installation of low-pressure metallic ductwork, joints and accessories.
- .2    Related Sections:
  - .1        Section 01 11 00 – General Requirements
  - .2        Section 07 84 00 - Firestopping.
  - .3        Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .4        Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

### **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 A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2        ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3        ASTM A653/A653M-03, 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), 1999, c. 33.
- .4    Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1        Material Safety Data Sheets (MSDS).
- .5    National Fire Protection Association (NFPA).
  - .1        NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2        NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3        NFPA 96-01, 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, 2nd Edition 1995 and Addendum No. 1, 1997.
  - .2        SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
  - .3        IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.
- .7    Transport Canada (TC).
  - .1        Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.



### **1.3 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Construction and Division 01 – General Requirements for the following:
  - .1 Sealants.
  - .2 Tape.
  - .3 Proprietary Joints.
- .3 Co-ordinate submittal requirements and provide submittals in accordance with Division 01 – General Requirements as applicable.
- .4 Submit Indoor Air Quality (IAQ) Management Plan in accordance with Division 01 – General Requirements as applicable.

### **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 Section 01 11 00 – General Requirements.
- .3 Indoor Air Quality (IAQ) Management Plan.
  - .1 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01 – General Requirements as applicable. Construction for construction and preoccupancy phases of building.
  - .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 Section 01 11 00 – General Requirements.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site 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:

Pressure Pa	SMACNA Seal Class
501-999	B
<= 500	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.
- .3 Class C: transverse joints and connections made air tight with gaskets sealant. Longitudinal seams unsealed.
- .4 Unsealed seams and joints.

### **2.2 SEALANT**

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

### **2.3 TAPE**

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 5 mm wide.

### **2.4 DUCT LEAKAGE**

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

### **2.5 FITTINGS**

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
- .1 Rectangular: standard radius short radius with single thickness turning vanes  
Centreline radius: 1.5 times width of duct.
- .2 Round: smooth radius 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 45 degrees entry on branch.
- .2 Round main and branch: enter main duct at 45 degrees with conical connection.

- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with splitter damper.
- .5 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
  - .1 Full radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.

## **2.6 LOW PRESSURE DUCTWORK**

- .1 All supply ductwork in mechanical rooms is to be constructed for 747 Pa (3.0"w.g.) operating pressure. Supply ductwork for constant volume systems is to be constructed for 498 Pa (2.0" w.g.) operating pressure. All return and exhaust ductwork to be constructed for 498 Pa (2.0" w.g.) operating pressure. Ductwork designed for 498 Pa (2.0" w.g.) operating pressure shall be constructed as per Table 1-5, SMACNA HVAC Duct Construction Standards.
- .2 Duct sizes 483mm (19") wide and larger with more than 0.929m<sup>2</sup> (10 sq. ft.) or embraced panel shall be beaded or cross broken. This shall also apply to 1.005mm (20 gauge) or less thickness and 747 Pa (3.0" w.g.) or less.
- .3 Concealed round branch ducts up to 406mm (16") diameter may be constructed with longitudinal seams. Concealed round branch ducts over 406mm (16") and all exposed round ducts shall be factory fabricated conduit consisting of helically wound galvanized steel strips with spiral lock seams. Fittings for these conduits shall be fabricated of 1.005mm (20 gauge) galvanized sheet steel with butt welded seams of standard dimensions. Long radius elbows shall be used where space permits. Where 90° take-offs are necessary, conical T's shall be used.

## **2.7 FIRE STOPPING**

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

## **2.8 GALVANIZED STEEL**

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

## **2.9 STAINLESS STEEL**

- .1 To ASTM A480/A480M, Type 304 for fume hood exhaust.
- .2 Finish: No. 4.

- .3 Thickness, fabrication and reinforcement: to SMACNA as indicated.
- .4 Joints: to ASHRAE and SMACNA be continuous inert gas welded.

## 2.10 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

- .1 Maximum size duct supported by strap hanger: 500.

- .2 Hanger configuration: to ASHRAE and SMACNA.

- .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size	Angle Size	Rod Size
(mm)	(mm)	(mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	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.
- .3 For steel beams: manufactured beam clamps.

## PART 3 EXECUTION

### 3.1 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, & SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
- .3 Support risers in accordance with SMACNA as indicated.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .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 where required.
- .7 Ground across flex connector with No. 2 braided copper 8 trap.

- .8 Seal and protect duct work during construction. Cover open ends.

### 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 as follows:

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

### 3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
  - .1 Fresh air intake.
  - .2 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
  - .1 Solder joints of bottom and side sheets.
  - .2 Seal other joints with duct sealer.

### 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 manufacturer's recommendations.

### 3.5 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Section 01 11 00 – General Requirements.
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Low-emitting materials.

### 3.6 OUTDOOR AIR AND EXHAUST OPENINGS

- .1 Install to SMACNA details.
- .2 Reinforce and brace air outlets and intakes for wind speed as per NBC for location.
- .3 Provide air outlet openings with 1.6129mm (16 gauge) thick 25mm (1") wire mesh screen and air inlet openings with 12mm (½") mesh screwed aluminum bird screens.
- .4 Slope plenum floors to the exterior to drain.

- .5 Interior of intake/exhaust plenums to be covered with waterproof membrane.

### **3.7 INSTRUMENT AND TEST HOLES**

- .1 Install 25mm (1") test plugs with chain and cap, where required to accommodate testing and balancing instruments.

### **3.8 DUCT LEAKAGE**

- .1 Ductwork shall be free of audible leaks in quiet ambient.

### **3.9 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 (1) coat of sealant to manufacturer's recommendations

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results - Mechanical.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all 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 facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 11 00 – General Requirements.
- .2 Indicate the following:
  - .1 Flexible connections;
  - .2 Duct access doors;
  - .3 Turning vanes; and
  - .4 Instrument test ports.

**1.4 COORDINATION**

- .1 Refer to Division 01 – General Requirements, Division 21 – Fire Suppression, Division 22 – Plumbing and Division 26 - Electrical for other requirements as included and outlined in other sections of the specifications.

**1.5 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.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Manufacture in accordance with CSA B228.1.
- .2 In accordance with applicable sections in Division 01 – General Requirements.

### **2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame 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°C to plus 90°C.

### **2.3 ACCESS DOORS IN DUCTS**

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum .853mm (22 gauge) thick complete with sheet metal angle frame and sealing gaskets.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum .853mm (22 gauge) thick complete with sheet metal angle frame and 25mm (1") thick rigid glass fibre insulation and sealing gaskets.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300mm x 300mm (12" x 12"): 2 sash locks complete safety chain.
  - .2 300mm x 457mm (12" x 18"): 4 sash locks complete with safety chain.
  - .3 457mm x 1016mm (18" x 40"): piano hinge and minimum 2 sash locks.
  - .4 Doors over 1016mm (40"): piano hinge and 2 handles operable from both sides.
  - .5 Hold open devices.

### **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 1.6129mm (16 gauge) thick steel zinc plated after manufacturer.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28.575mm (1-1/8") minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.



## **PART 3 EXECUTION**

### **3.1 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: 150mm (6").
  - .3 Minimum distance between metal parts when system in operation: 75mm (3").
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on each side of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
  - .6 Provide a grounding strap at each flexible connection.
- .2 Access Doors:
  - .1 Size:
    - .1 600mm x 600mm (24" x 24") for person size entry.
    - .2 600mm x 600mm (24" x 24") for servicing entry.
    - .3 300mm x 300mm (12" x 12") for viewing.
    - .4 As indicated.
  - .2 Location:
    - .1 At fire and smoke dampers.
    - .2 At control dampers.
    - .3 At devices requiring maintenance.
    - .4 At locations required by code.
    - .5 Elsewhere as indicated.
    - .6 At 9.144m (30 ft.) intervals.
    - .7 At elbows with turning vanes.
    - .8 Fresh air and exhaust air plenums.
    - .9 At bottom of risers.
    - .10 Before and after coils.
    - .11 At filters.
    - .12 At fans.
    - .13 At automatic dampers.
- .3 Instrument test ports.
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .2 Locations:
    - .1 For traverse readings:
      - .1 At ducted inlets to roof and wall exhausters.
      - .2 At inlets and outlets of other fan systems.
      - .3 At 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 And as indicated.
- .4 Turning vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.
  - .2 Provide where long radius turns or two 45° elbows cannot be used because of space considerations.

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results – Mechanical.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all 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 facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

**1.3 REFERENCES**

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible-2005, except where specified otherwise.

**1.4 COORDINATION**

- .1 Refer to Division 01 – General Requirements, Division 21 – Fire Suppression, Division 22 – Plumbing and Division 26 - Electrical for other requirements as included and outlined in other sections of the specifications.

**1.5 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 11 00 – General Requirements.

**PART 2 PRODUCTS**

**2.1 GENERAL**

- .1 Manufacture to SMACNA standards.
- .2 All damper rods to extend through both sides of the ducts.

**2.2 SPLITTER DAMPERS**

- .1 Of same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Single thickness construction.
- .3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

.6 Folded leading edge.

## **2.3 SINGLE BLADE DAMPERS**

.1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 200mm (8").

.3 Locking quadrant.

.4 Inside and outside end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

## **2.4 MULTI-BLADED DAMPERS**

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration to recommendations of SMACNA.

.3 Maximum blade height: 100mm (4").

.4 Bearings: pin in bronze bushings.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 For supply, return and exhaust systems, balancing dampers are to be located in each branch duct.

.4 Each grille, register and diffuser connection to have balancing damper located as close as possible to main ducts.

.5 Install splitter damper blade, pivot and control rod in rigid manner to prevent vibration. Use splitter damper only where no other means are available.

.6 Provide single blade dampers in branch take-offs for volumes up to 472 l/s (1000 CFM) and opposed blade dampers for volumes over 472 l/s (1000 CFM).

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results – Mechanical.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all 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 facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

**1.3 GENERAL**

- .1 This section applies to operating dampers.

**1.4 COORDINATION**

- .1 Refer to Division 01 – General Requirements, Division 21 – Fire Suppression, Division 22 – Plumbing and Division 26 - Electrical for other requirements as included and outlined in other sections of the specifications.

**1.5 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 11 00 – General Requirements.
- .2 Indicate the following:
  - .1 Performance data.

**1.6 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 11 00 – General Requirements.

**1.7 CERTIFICATION OF RATINGS**

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

**PART 2 PRODUCTS**

**2.1 BACK DRAFT DAMPERS**

- .1 Automatic gravity operated, multi-leaf, aluminum construction with nylon bearings, centre pivoted spring assisted or counter-weighted, as indicated.

## **2.2 DAMPER**

- .1 Sizes:
  - .1 Blades maximum 150mm wide x 1219mm long (6" wide and 48" long).
  - .2 Modular maximum 1219mm x 2438mm (48" wide x 96" high).
  - .3 Multiple sections with stiffening mullions and jack shafts.
- .2 Materials:
  - .1 Frame: 2.752mm (12 gauge) thick aluminum.
  - .2 Blades: two sheets .853mm (22 gauge) thick or 1.6129mm (16 gauge) thick aluminum , insulated.
  - .3 Bearings: oil impregnated sintered nylon. Provide additional thrust bearings for vertical blades.
  - .4 Linkage and shafts: zinc plated steel.
  - .5 Seals: replaceable neoprene seals or "ss" spring on side, top and bottom of frame and along all blade edges and blade ends.
- .3 Provide performance characteristics as follows:
  - .1 5 l/s (10 cfm) per sq. ft. max. allowable leakage against 1000 kPa (145 psi) static pressure.
  - .2 Temperature range -40°C to 93°C.

## **2.3 MULTI-LEAF DAMPERS**

- .1 Sizes: or parallel blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel 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: electronic type provided by Division 23. Dampers and jack shifting by Division 23 – Heating, Ventilation and Air Conditioning (HVAC). Damper actuators by Division 23. Coordinate torque requirements for proper performance.
- .6 Performance:
  - .1 Leakage: in closed position less than 2% of rated air flow at 1250 Pa differential across damper.
  - .2 Pressure drop: at full open position less than 25 Pa differential across damper at 15 m/s.
- .7 Insulated Aluminum Dampers:
  - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88 for all fresh air and exhaust air connections.
  - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

**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        Upon system start-up, ensure that dampers operate properly.
- .5        All fresh air and exhaust air dampers shall be insulated aluminum dampers.

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results – Mechanical.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all 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 facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

**1.3 REFERENCES**

- .1 ANSI/NFPA 90A-2009 - Installation of Air Conditioning and Ventilating Systems.
- .2 CAN4-S112-M82(R1987) - Fire Test of Fire Damper Assemblies, except specified otherwise.
- .3 CAN4-S112.2-M84 - Fire Test of Ceiling Firestop Flap Assemblies.
- .4 ULC-S505 - Fusible Links for Fire Protection Service.

**1.4 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 11 00 – General Requirements.
- .2 Indicate the following:
  - .1 Fire dampers.
  - .2 Fire stop flaps.
  - .3 Fusible Links.

**1.5 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 11 00 – General Requirements.

**1.6 MAINTENANCE MATERIALS**

- .1 Provide following:
  - .1 Six (6) fusible links of each type.



## **1.7 COORDINATION**

- .1 Refer to Division 01 – General Requirements, Division 21 – Fire Suppression, Division 22 – Plumbing and Division 26 - Electrical for other requirements as included and outlined in other sections of the specifications.

## **1.8 CERTIFICATION OF RATINGS**

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

## **PART 2 PRODUCTS**

### **2.1 FIRE DAMPERS**

- .1 Fire dampers: listed and bear label of ULC, meet requirements of NFPA 90A.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: galvanized steel interlocking blades, 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 horizontal position with vertical air flow.
- .5 38mm x 12mm x 3mm (1-1/2" x 1/2" x 1/8") retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Fire damper assemblies to be fire tested in accordance with CAN4-S112.
- .3 Maintain integrity of fire separation.
- .4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .5 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .6 Coordinate with installer of firestopping.
- .7 Use Type C fire dampers on round ductwork.

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results - Mechanical.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all 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 facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

**1.3 REFERENCE STANDARDS**

- .1 Do work in accordance with the following standards except where specified otherwise:
  - .1 CAN/ULC S110-M07 for Fire Tests for Air Ducts.
  - .2 UL 181- 2005 for Factory Made Air Ducts and Connectors.
  - .3 ANSI/NFPA 90A - 2009 for Installation of Air Conditioning and Ventilating Systems.
  - .4 ANSI/NFPA 90B - 2009 for Installation of Warm Air Heating and Air Conditioning systems.
  - .5 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

**1.4 PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements.
- .2 Indicate the following:
  - .1 Thermal properties.
  - .2 Friction loss.
  - .3 Acoustical loss.
  - .4 Leakage.
  - .5 Fire rating.

**1.5 COORDINATION**

- .1 Refer to Division 01 – General Requirements, Division 21 – Fire Suppression, Division 22 – Plumbing and Division 26 - Electrical for other requirements as included and outlined in other sections of the specifications.

**1.6 CERTIFICATION OF RATINGS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

**PART 2 PRODUCTS**

**2.1 GENERAL**

- .1 Factory fabricated to CAN/ULC 110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

**2.2 FLEXIBLE DUCTWORK**

- .1 Comply with requirements of ULC "Standards for Safety, Air Ducts", ULC S110-2007, and NFPA 90A-2009.
- .2 Spiral wound, flexible perforated aluminum duct. Unit must withstand 2488 Pa (10" w.g.) internal pressure.
- .3 Thermally insulated ductwork: Flexible glass fibre, nominal thickness of 25mm (1") factory applied, unless otherwise specified, with PVC exterior vapour barrier.

**PART 3 EXECUTION**

**3.1 DUCT INSTALLATION**

- .1 Locate between air control boxes and all grilles, registers and diffusers.
- .2 Support flexible ducts at 1.219m (48") centers. Minimum of two hangers per length.
- .3 Maximum length of flexible duct connections shall be 2.438m (96").
- .4 Connections between flexible duct and terminal devices to be made airtight with duct tape.
- .5 No change in direction with flex ductwork shall exceed 15°. For changes in direction of more than 15° use rigid ductwork. Provide rigid sheet metal elbows at air terminal devices.
- .6 Connections between flexible duct and terminal devices to be made air tight with duct tape.

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results – Mechanical.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .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 Divert unused metal materials from landfill to metal facility as approved by Departmental Representative.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 11 00 – General Requirements.
- .2 Indicate the following:
  - .1 Capacity.
  - .2 Throw and terminal velocity.
  - .3 Noise criteria.

**1.4 MAINTENANCE MATERIALS**

- .1 Include:
  - .1 Keys for volume control adjustment.
  - .2 Keys for air flow pattern adjustment.

**1.5 MANUFACTURED ITEMS**

- .1 Grilles, registers and diffusers shall be product of one manufacturer for generic type.

**1.6 COORDINATION**

- .1 Refer to Division 01 – General Requirements, Division 21 – Fire Suppression, Division 22 – Plumbing and Division 26 - Electrical for other requirements as included and outlined in other sections of the specifications.

**1.7 CERTIFICATION OF RATINGS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

## **PART 2 PRODUCTS**

### **2.2 GENERAL**

- .1 Standard product to meet capacity, throw, noise level, throat and outlet velocity as indicated.
- .2 Provide volume control dampers on all supply diffusers and concealed operators.
- .3 Sizes indicated are nominal. Provide correct standard product nearest to nominal for capacity throw, noise level, throat and outlet velocity.
- .4 Furnish factory prime coated steel frames for setting into fire protecting membrane. At aluminum diffusers, registers and grilles, provide 1.2mm thick minimum steel collar up to fire damper or fire stop flap, for suspending from the basic structure independently of membrane pierced to maintain fire protection membrane integrity.
- .5 Where penetrating fire partitions, provide approved steel sleeve attached to structure and secured in accord with NFPA 90A-1978. Where penetrating fire walls provide 3.510mm (10 gauge) thick steel sleeve with angle iron perimeter frame to NFPA 90A-2009.
- .6 Frames:
  - .1 Steel: standard cold rolled steel with exposed joints welded and ground flush and completely closed.
  - .2 Aluminum: satin finish with mechanical fasteners and completely closed corners.
  - .3 Provide full perimeter sponge rubber gaskets.
  - .4 Provide plaster frames as plaster stops set into gypsum board at all locations.
  - .5 Provide concealed fasteners and operators.
- .7 Finish:
  - .1 Off white baked enamel unless otherwise indicated.

### **2.3 RETURN / EXHAUST AIR GRILLES / REGISTERS**

- .1 Type "RG/E" Return Exhaust Air Grilles
  - .1 Heavy Duty Extruded aluminium construction with 45 degree deflection, 13mm blade spacing, 32mm border.

### **2.4 DIFFUSERS**

- .1 General: volume control dampers with flow straightening devices and blank off quadrants and gaskets.
- .2 Type S: steel aluminum, square cone type, having fixed pattern, drywall mounted.

### **2.5 LINEAR GRILLES**

- .1 Bar core type with margin as indicated no margin.
- .2 Plaster frame, sealing strip and accessories as indicated.
- .3 Air volume control damper with concealed adjustment.
- .4 Type SL: as per schedules on drawings.

**PART 3        EXECUTION**

**3.1            INSTALLATION**

- .1        Install in accordance with manufacturer's instructions.
- .2        Install with cadmium plated screws in countersunk holes where fastenings are visible.
- .3        Examine ceiling plans and ceiling type to ensure the appropriate trim is provided to match diffusers/grilles with ceilings.

END

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results - Mechanical.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all 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 facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 11 00 – General Requirements.
- .2 Indicate the following:
  - .1 Louvre free area.
  - .2 Louvre water penetration.

**1.4 COORDINATION**

- .1 Refer to Division 01 – General Requirements, Division 21 – Fire Suppression, Division 22 – Plumbing and Division 26 - Electrical for other requirements as included and outlined in other sections of the specifications.

**1.5 CERTIFICATION OF RATINGS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

**1.6 TEST REPORTS**

- .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

**PART 2 PRODUCTS**

**2.1 STATIONARY LOUVRES**

- .1 Construction: welded with exposed joints ground flush and smooth.

- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: storm proof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500mm (60").
- .4 Frame, head, sill and jamb: 150mm (6") deep one piece extruded aluminum, minimum 2.953mm (12 gauge) thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500mm (60") maximum centres.
- .6 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, stainless steel washer and aluminum body.
- .7 Screen: 12mm (½") intake, 19mm (¾") exhaust mesh, 1.6mm (1/16") dia. wire aluminum birdscreen on inside face of louvres face of louvres in formed U-frame.
- .8 Finish: factory applied enamel. Colour: to Architects approval.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 In accordance with manufacturers and SMACNA recommendations.
- .2 Reinforce and brace air vents, intakes and goosenecks as indicated.
- .3 Anchor securely into openings. Seal with caulking all around to ensure weather tightness.
- .4 Slope all plenums to drain through louvers. Flush inside of plenums with 100% coverage of blueskin "peel and stick" waterproofing. Lap Blueskin of plenum to drain to outside the wall assembly waterproofing.
- .5 Inspect all louvers to duct connections to ensure there is no ridge or fold that will retain water.
- .6 Contractor to provide field fabricated thermally insulated blank-off panel on all un-used louver openings. Panel construction shall be pan-in-Pan with 1.6mm aluminium sheet metal and 100mm thick semi rigid, non-combustible mineral wool, thermal insulation board, R-4.2 per 25mm and sealed to make water proof. Silicone exterior side of panel to match louver colour. Seal and mechanically fasten blank off panel to the interior face of louver.
- .7 For louvres serving more than one air system, provide separate plenums for each air system. Divide Louvre area in proportion to the airflow of each system.

END



**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials, components and installation for heat reclaim devices.
- .2 Sustainable requirements for construction and verification.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 – Common Work Results – Mechanical.

**1.3 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 84-2013, Method of Testing Air-to-Air Heat Exchangers (ANSI approved).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.4 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 11 00 – General Requirements. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 11 00 – General Requirements.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 11 00 – General Requirements.
- .3 Quality assurance submittals: submit following in accordance with Section 01 11 00 – General Requirements.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .4 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 11 00 – General Requirements.
- .5 Certificates:

- .1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
- .2 Provide confirmation of testing.

## **1.5 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 11 00 – General Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 11 00 – General Requirements.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 11 00 – General Requirements.

## **1.7 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 11 00 – General Requirements.
  - .2 Furnish list of individual manufacturer's recommended spare parts for equipment include:
    - .1 Bearings and seals.
    - .2 Addresses of suppliers.
    - .3 List of specialized tools necessary for adjusting, repairing or replacing.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Comply with ASHRAE 84.

### **2.2 ENERGY RECOVERY VENTILATORS**

- .1 Casing:
  - .1 Casing to be constructed of prepainted galvanized 24GA steel, with 25mm fiberglass insulation.
- .2 Energy Recover Core:
  - .1 Core to recover both sensible and latent energy from exhaust air stream. Core to be constructed from a polymeric membrane. Energy recovery core performance as per drawings. Core shall have sufficient winter performance that a drain line is not required.

- .3 Blowers:
  - .1 Unit to have two backward inclined motorized fans with direct drive EC motors. Motors shall be sized to meet fan performance as indicated.
- .4 Filters:
  - .1 Unit to be supplied with filters to protect blowers and energy recovery core.
- .5 Electrical:
  - .1 Electrical to be as indicated on drawings. Unit to have a junction box for hard wired connection.
- .6 Controls:
  - .1 Unit shall be complete with internal defrost, controlled by the unit

## **2.3 FABRICATION**

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely.

## **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 recommendations.

### **3.3 FIELD QUALITY CONTROL**

- .1 Tests:
  - .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

### **3.4 CLEANING**

- .1 Proceed in accordance with Section 01 11 00 – General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

### **3.5 COMMISSIONING**

- .1 Building Commissioning as per Division 01 and 23 05 00 – Common Work Results for HVAC.

END

## **PART 1 GENERAL**

### **1.1 SECTION INCLUDES**

- .1 This Section covers items common to Sections of Division 26, Division 27, Division 28, and Division 33. This section also covers sections 23 82 33 and 48 14 00. This Section also supplements requirements of Division 01.

### **1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

### **1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2021, Canadian Electrical Code, Part 1 (25<sup>th</sup> Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.3 No. 7-2020, Underground Systems
  - .3 CSA/CAN3 C235:19, Preferred Voltage Levels for AC Systems, 0 to 50 000 V
- .2 Health Canada Workplace Hazardous Materials Information System (WHMIS):
  - .1 Safety Data Sheet (SDS).
- .3 Institute of Electrical and Electronics (IEEE):
  - .1 IEEE 100-2000, The Authoritative Dictionary of IEEE Standards Terms.
- .4 National Research Council of Canada (NRCC):
  - .1 NBC-2015, National Building Code of Canada
- .5 Underwriters Laboratories (UL) Standards.

### **1.4 DEFINITIONS**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE 100.

### **1.5 CONTRACT DRAWINGS**

- .1 No omissions in the drawings or specifications are intended and the Contractor shall give due consideration to this matter. Any work or material referred to in the drawings and not in the specifications, or vice versa, shall be furnished and performed as though fully covered in both. This shall apply particularly to the drawings where descriptions are sufficiently detailed so as to require little or no mention in the specifications. Items indicated on floor plans and not on riser diagrams, or vice versa, shall be considered fully covered by both.
- .2 Runs of conduit and outlet locations indicated on the drawings are diagrammatic and exact locations must be determined by the Contractor as the work proceeds, with due regard to the structure and the work of other trades. The Consultant reserves the right to alter locations of conduit and outlets up to 3 m without extra cost, provided that the Contractor is advised prior to roughing in. The Contractor shall make any changes dictated by structural requirements, or conflicts with other trades, without charge to the Departmental Representative.

- .3 Any error or omission shall be referred to the Departmental Representative whose decision shall be final.
- .4 Building dimensions shall not be scaled from the electrical drawings but shall be obtained from the Architectural and/or Structural drawings. Any discrepancy between the drawings and the building shall be questioned before proceeding with the installation.

## **1.6 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CSA/CAN3 C235.
- .2 Distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

## **1.7 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.
- .2 Shop drawings:
  - .1 The Contractor shall prepare shop drawings showing in detail the design and construction of all equipment, panels, cabinets, lighting fixtures, etc.. High quality electronic “PDF” copies of shop drawings shall be submitted to the Departmental Representative for review, and the work shall not be executed until such review has been obtained.
  - .2 All shop drawings, other than standard manufacturers' dimensions and data sheets, shall bear the stamp of a registered professional Engineer who shall be fully responsible for the Engineering content of such drawings.
  - .3 Prior to submission the Contractor shall carefully check all shop drawings to ensure that they comply with the drawings and specifications in both intent and detail. No consideration will be given to shop drawings submitted without this approval and review from the Contractor. Appendix A at the end of this section must be completed and signed and must accompany all shop drawing submissions. Submissions not accompanied by Appendix A will be returned for re-submission.
  - .4 The Departmental Representative review of these drawings is general and is not intended to serve as a check and shall not release the Contractor from responsibility for errors or from the necessity of checking the drawings themselves, or of furnishing the materials and performing the work as required by the plans and specifications.
- .3 Quality Control:
  - .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.

- .5 Submit, upon completion of Work, load balance report as described in Part 3 - Load Balance.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .4 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

## **1.8 QUALITY ASSURANCE**

- .1 Qualifications: electrical Work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
  - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

## **1.9 SYSTEM STARTUP**

- .1 At the conclusion of the job, the Contractor shall review and demonstrate to the Departmental Representative, all electrical equipment and their respective functions and operation. Such demonstration shall be provided for such reasonable periods of time as the complexity of the job warrants, and as approved by the Departmental Representative. Such review and demonstration shall be made by an authorized representative of the Contractor, who shall be fully knowledgeable of the project, its installation and operation. Three bound maintenance and operational manuals shall be reviewed and left with the Departmental Representative. These manuals shall be custom written for materials and systems supplied for this project. Generic information may accompany the manuals but must only be supplemental information. These manuals shall include, but not be limited to, training lists, final inspection report(s) from the authority having jurisdiction, approved copies of all shop drawings, guarantees, manufacturers maintenance instructions, diagrams, and parts lists, all packaging and installation instructions, and all operating instructions. Where manufacturers' literature is not available, or appropriate, the Contractor shall provide same in written form. This shall apply particularly to the general light, power and control system. Refer also to Section 01 11 00 – General Requirements. Prior to final inspection, submit these manuals to the Departmental Representative for review.
- .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.

## **1.10 MINIMUM STANDARDS**

- .1 All work shall be performed in accordance with CSA C22.1 and NBC as minimum standards. These standards together with all Local or Municipal Rules, Regulations, and Ordinances shall be considered as the Latest Approved Editions at the time of Tender Closing. In no instance, shall the standard established by the drawings and specifications, be reduced by any codes.

**1.11 PERMITS, FEES AND INSPECTION**

- .1 The Contractor shall obtain all inspections and permits required by all laws, ordinances, rules, and regulations by public authority having jurisdiction in this district, and shall obtain certificates of such inspections and shall pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due.
- .2 In no instance shall the standard established by the drawings and specification be reduced by any codes, etc.

**1.12 SUPERVISION**

- .1 The Contractor shall provide supervision and sufficiently qualified foreman to ensure that the job proceeds in a proper and efficient manner. If in the opinion of the Departmental Representative, such personnel are not competent to carry out their work, the Contractor shall replace these men immediately upon written request of the Departmental Representative.

**1.13 OTHER TRADES**

- .1 The Contractor shall co-operate and investigate with other trades to make maximum use of the spaces and avoid conflict with pipes, ducts, equipment radiation, etc. Shop drawings shall be prepared by the Contractor indicating the route of main conduits and ducts which shall be submitted to the Departmental Representative for review.
- .2 The Contractor shall co-operate with other Contractors on the site and carry out the work, in such a way, as not to hinder or hold-up the work of other trades.
- .3 The Contractor shall consult with other Contractors, where their respective installations conflict and shall re-route conduits, ducts, outlets, equipment, etc., as required, subject to the approval of the Departmental Representative.
- .4 The Contractor shall obtain from the mechanical and other trades complete detailed wiring diagrams of equipment requiring connections and shall be responsible for pointing out any discrepancies or the reason why they cannot be adhered to.

**1.14 FIRE PENETRATIONS**

- .1 Where conduits and cables pass through fire separations and sound rated separations, including floors, walls, membranes, etc., provide a metallic sleeve, or core drill to 25.4mm radius larger than the conduit or cable passing through the fire separation. Construct a ceramic fibre insulation dam, or dams as required, and fill the penetration with fire rated putty or 3m chalk. A minimum depth of 51mm of putty or caulk is required. Installation shall be in strict accordance with manufacturers' recommendations and to suit UL and/or ULC requirements. All such work shall be performed by personnel familiar and experienced with this type of work.

**1.15 GUARANTEE**

- .1 The Contractor shall guarantee all work, under this Division, free from defects, for a period of one (1) year, after final acceptance of the entire project. The Contractor shall make good all defects, other than normal wear and tear, during the life of the guarantee. Notwithstanding the above, longer guarantees may be required for specific installations or equipment, as indicated in other sections of the specifications.
- .2 Guarantees shall be submitted in writing, bound where more than one is required, and submitted to the Departmental Representative for review. Each guarantee shall include:

- .1 Project name and address.
- .2 Guarantee time period (commencement date shall be the date as shown on the project final certificate of completion, unless otherwise indicated).
- .3 Clear and concise definition of what is guaranteed.
- .4 Signatures of company officers of the Contractor and/or manufacturers, as applicable.

## **1.16 RECORD DRAWINGS**

- .1 One (1) set of white prints will be provided for record drawing purposes. Maintain project "as-built" record drawings and accurately record significant deviations from the Contract Documents, caused by site condition or Contract change. Mark changes on white prints in "RED".
- .2 Identify each drawing in the lower right hand corner in letters at least 12.7mm high as follows:
  - .1 "AS-BUILT DRAWINGS"
  - .2 (This drawing has been revised to show electrical systems as installed)
  - .3 (Signature of Contractor)
  - .4 (Date).
- .3 Submit as-built drawings to Departmental Representative for approval. Make all corrections as directed.
- .4 Prior to start of testing, balancing and adjusting, finalize production of as-built drawings.
- .5 Testing, balancing and adjusting to be performed using as-built drawings.
- .6 Turn over the as built drawings to the owner at the completion of the project.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS AND EQUIPMENT**

- .1 Contract materials shall be new and CSA approved for their specific use.
- .2 For the purposes of uniformity similar materials shall be of one manufacturer (i.e. all panels and switchgear; all motor control equipment; all light fixtures in as much as is possible; etc.)
- .3 To avoid the possibility of the work being delayed, the Contractor shall order all materials as soon as possible, and he shall report at once to the Departmental Representative any delays in the delivery of materials which would hold up the completion of the job.
- .4 "Approved Manufacturers" catalogue designations are included in portions of this specification and also on the drawings. Manufacturers and equipment not listed, are not acceptable. Requests for approval of alternatives to the equipment specified, may be submitted to the Departmental Representative for consideration ten (10) days prior to Tender closing. Where such approvals are granted, the Contractor shall assume full responsibility for the use of alternates with respect to conformance with the specifications, and physical limitations incurred.

### **2.2 WARNING SIGNS**

- .1 Warning Signs: As specified and in accordance with requirements of Electrical Inspection Department and Departmental Representative.



- .2 Decal signs, minimum size 178mm x 2.54mm.

### 2.3 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

### 2.4 EQUIPMENT IDENTIFICATION

- .1 All panelboards, disconnect switches, transformers, etc. are to be provided with "lamicoid" nameplates as further described herein. Care is to be taken to ensure that all plates are affixed true and level, and plumb in all instances.
- .2 Nameplates are to be affixed to all "metal" surfaces with steel type "pop-rivets". Care shall be taken to ensure that rivets do not interfere with the operation of the equipment.
- .3 Nameplates are to be affixed to other types of surfaces with contact type cement.
- .4 Nameplates are to be affixed to building "exterior" surfaces with nylon inserts and self tapping screws unless specifically indicated otherwise.
- .5 Contact type cement is to be applied (buttered) to complete rear side of plate, as opposed to several locations or areas on same
- .6 Lamicoid nameplates installed on distribution panelboards, motor control centres, splitter troughs, transformers, etc. shall indicate the following:
  - .1 Designated name of equipment.
  - .2 Amperage of overcurrent protection device.
  - .3 Voltages, number of phases and wires.

- .4 Designation of power source

- .1 Example:

PANEL 101 – 150AMPS 120/208V–3PH–4W FED FROM MAIN SWITCHBOARD
---

- .7 Lamicoid nameplates installed on disconnect switches, etc. shall contain the following information.

- .1 Designated name of equipment.
  - .2 Designated name of power source.
  - .3 Branch circuit breaker number(s) where possible.
  - .4 Voltage(s).

- .1 Example:

EXHAUST FAN NO. 1 PANEL H – 120V CCT. NO.17
---

- .8 Lamicoid nameplates installed on fusible type disconnect switches are to also indicate maximum designated/designed fuse size.

- .9 Lamicoid nameplates are to be installed on all junction and/or pull boxes sized 152.4mm x 152.4mm and larger indicating name of system, designated panel name and electrical characteristics where applicable.
- .10 Lamicoid nameplates are to be installed adjacent to each overcurrent devices located in switchboards, CDP panels, etc.. They need only indicate designated name and/or number of equipment they feed. Unused O.C. devices are to be identified as spare(s). Provide new lamicoid nameplates for all existing breakers in the main switchboard and existing 120/208V distribution panelboard.
- .11 Lamicoid nameplates installed on "main" service entrance switches, or "main" entrance switchboards to indicate the following information on minimum size 152.4mm x 2plate complete with two lines of 12.7mm high lettering. (Size #8 nameplate.)

.1 Example:

MAIN BREAKER 600 AMPS 100% RATED 347/600V-3PH-4W
--

- .12 Install an additional "lamicoid" nameplate on all, or any piece of electrical equipment, or apparatus (i.e.: main switchboard, CDP panels, panelboards, motor control centres, etc.) that may contain overcurrent devices, i.e. circuit breakers and/or fuses, that have been designed for, and incorporate interrupting capacity sized "larger" than 10 kAIC.

.1 Examples:

Minimum interrupting capacity of breakers installed in this panel to be not less than 20 kAIC.
--

Minimum interrupting capacity of fuses installed in this MCC to be not less than 20 kAIC.
---

- .13 Allow for an "average" of forty letters for each lamicoid nameplate.

- .1 Lamicoid 3.175mm thick plastic engraving sheet, black letters, white face, for all electrical systems except fire alarm systems which shall have white letters on red face.
- .2 1.59mm thick nameplates above receptacles as previously indicated, with top left and right corners to be rounded off.
- .3 Lettering on lamicoid nameplates shall not "start" or "end" nearer than 9.525mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates shall be as indicated in the following chart.
- .4 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10mm x 51mm	1 line	5mm high letters
Size 2	13mm x 76mm	1 line	6mm high letters
Size 3	16mm x 76mm	2 lines	5mm high letters

NAMEPLATE SIZES			
Size 4	19mm x 89mm	1 line	10mm high letters
Size 5	38mm x 89mm	2 lines	13mm high letters
Size 6	25mm x 102mm	1 line	13mm high letters
Size 7	38mm x 102mm	2 lines	6mm high letters
Size 8	51mm x 152mm	2 lines	13mm high letters

- .14 Labelling of all branch circuit phase and neutral conductors to be done on both ends of all circuit conductors plus in "all" junction and/or pull boxes located in between. Use write-on, self-laminating labels sized as necessary. To be installed in a "flagged" manner around individual conductor(s).
- .15 Coverplates for junction and/or pull boxes located above finish ceilings housing branch circuits are to have each branch circuit number neatly identified on coverplate. Felt marker-pen may be used for this purpose.
- .16 All of the following conductors are to have their insulation colours identified as indicated:

Phase A	Red
Phase B	Black
Phase C	Blue
Neutral	White/Grey
Bond	Green
Ground	Green
Isolated Ground	Green c/w Yellow Strip

- .1 Colour code conductor insulation and others as per the following:
  - .1 All sizes of phase conductors up to and including #2 AWG.
  - .2 All sizes of neutral, bond and/or ground conductors, up to and including #3/0 AWG.
- .2 Approved coloured tapes in lieu of insulation colouring may be used to identify conductors that exceed sizes as indicated in items .16.1.1 and .16.1.2 above, and is to take place on both ends of runs for a minimum of 30.5mm from where terminations take place.
- .17 Bonding conductors require labelling on both ends of runs where they are "dedicated" solely to the designated branch circuit they accompany. Identify with same number(s) being used to identify accompanying branch circuit phase and neutral conductor.
- .18 All junction and/or pull boxes, conduit fittings (and covers), etc., complete with their respective coverplates are to be colour coded as per the following. Boxes are to be coloured both inside and outside, where "one" colour only is required. Boxes are to be coloured on inside only where "two" colours are required. Metal coverplates are to have both colours applied diagonally where "two" colours are required. Complete plate is to be painted where one colour only is required.
- .19 All various systems concealed junction and/or pull boxes located within ceiling spaces are to have their locations identified on room side of T-bar grid spline or access cover frames with appropriate colour coded, circular shaped, self adhering discs. Discs are to be both, 19mm and 6mm in diameter, as described in the following legend, with 6mm discs being centred in the middle of ¾" discs. Concealed junction, pull and/or outlet

boxes, conduit fittings, etc., in ceiling spaces complete with their respective metal coverplates.

- .20 A legend of colour coding used is to be provided under plexiglass and located in the main electrical room, 915mm x 610mm minimum size frame.

Various Systems	19mm Disc	6mm Disc
.1 241 to 600 volts	Orange	
.2 51 to 240 Volts	Yellow	
.3 Ground or Bond Green		

- .21 Schedules shall be installed on the back of each door for panels, neatly arranged and mounted in frame under transparent cover. Schedules shall show system voltage, which outlets are on each circuit and any special information necessary. Schedules shall be typewritten and of a permanent nature.

## 2.5 WIRING IDENTIFICATION

- .1 Identify wiring on both ends of phase conductors of feeders and branch circuit wiring by circuit number at all panelboards, pull and junction boxes, outlet and equipment connections, and all devices. Labels shall be Panduit PLD-1 or PLD-2 as required. Labels to be installed in such a manner as to present white area with information in "flagged" position. Wrap around conductor in "U" fashion and have it adhere to itself. Identify neutrals and bond wires indicating which circuits with which they are used.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 The individual conductors and conductor pairs used in the various communications cables shall be colour coded. Maintain the colour coding scheme for each system throughout.

## 2.6 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 15.25m intervals.
- .3 Colours: 25mm wide prime colour and 19mm wide auxiliary colour.
- |    | System            | Prime  | Auxiliary |
|----|-------------------|--------|-----------|
| .1 | up to 250V        | Yellow |           |
| .2 | up to 251 to 600V | Orange |           |

## 2.7 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 indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

## **2.8 ACCESS DOORS**

- .1 Supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating or fire devices for installation under section erecting the walls or ceilings.
- .2 Access doors shall be flush mounted 610mm x 610mm for body entry and 305mm x 305mm for hand entry, unless otherwise noted. Doors shall open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Doors shall be of approved manufacturer with published literature. Access doors shall be minimum 14 gauge thick.
  - .1 General: Prime coated steel.
  - .2 Special areas such as tiled or marble surfaces: stainless steel.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do underground systems in accordance with CSA C22.3 No.7 except where specified otherwise

### **3.2 NAMEPLATES AND LABELS**

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

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

- .1 Install conduit and sleeves prior to the pouring of concrete, laying of concrete block, and the installation of drywall partitions.
- .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 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 250 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3.05m, and information is given before installation.
- .4 Locate light switches on latch side of doors.
  - .1 Locate disconnect devices in mechanical rooms on latch side of door.

### **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 equipment at following heights unless indicated otherwise.
  - .1 Panelboards: 1.83m to top as required by Code or as indicated.

### **3.6 MOTOR AND EQUIPMENT CONNECTIONS**

- .1 Provide final connections to all motors, equipment, controls, etc. indicated on the drawing. These motors, equipment, controls, etc. shall include those supplied under other sections of this specification, as well as Departmental Representative supplied items. Ensure that equipment will operate properly (e.g. proper rotation) and report any instance of defective equipment to the Departmental Representative.

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

- .1 This contractor shall adjust overcurrent devices as directed by the Consultant.
- .2 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### **3.8 CUTTING AND PATCHING**

- .1 Any patching or cutting required to accommodate the equipment shall be the responsibility of Division 26.
- .2 Make every effort to minimize cutting and patching by providing dimensions, locations and other data for bases, sleeves, boxes, etc., to be built in as construction proceeds. Set sleeves and mark openings in concrete forms and masonry before placing concrete and masonry.

### **3.9 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment. Such adjustments shall be made under normal load conditions.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests:
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: communications.

- .6 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
  - .2 Megger 350-600V circuits, feeders and equipment with a 1000V instrument.
- .3 Check resistance to ground before energizing.
- .4 Test all wiring included in the Contract, to ensure there are no shorts or grounded conductors and that insulation values are as required by the Canadian Electrical Code
- .5 The Engineer reserves the right to use any piece of electrical equipment, device, or material installed under this Contract for such reasonable lengths of time and at such times as they may require to make a complete and thorough test of the same, before the final completion and acceptance of the work
- .6 The following wiring methods detailed below are designed to enhance the ability to perform capacitive leakage tests; these methods are to be strictly followed and tests performed under this Contract
  - .1 All circuit conductors are to be individually tie wrapped to their corresponding labelled neutral conductor in all panelboards, pull boxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually tie wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality
  - .2 The tie wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pull boxes and junction boxes.
  - .3 The main switchboard, CDP's, panelboards, MCC's, etc. are to have their respective feeder phase and neutral conductors tie wrapped together and enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is to be neat and of good workmanship quality. The main electrical switchboard is to have each of its sub-feeder phase conductors tie wrapped together with each respective neutral. This tie wrapping is to be located such that ease of clamping the ground detector can be accomplished without excessive exposure to live bus.
  - .4 After all electrical wiring has been completed by the Electrical Sub-Contractor, he is to test the grounded electrical distribution system to ensure there are not ground shorts, and capacitive leakage in the system is within acceptable limits
  - .5 All feeders or branch circuits, which do not have neutral conductors, are to have their respective phase conductors tie wrapped together in accordance with the methods described previously.
- .7 Submit properly prepared and bound reports of all tests indicating:
  - .1 The date and time of the test.
  - .2 The name or names of those who conducted the test.
  - .3 The purpose of the test.
  - .4 The results of the test.
  - .5 Any applicable code limits or bounds.
- .8 Such tests shall not be construed as evidence of acceptance of any part of the Contract, and it is agreed and understood that no claim for damage will be made for any injury or breakage to any part or parts of the above, due to the aforementioned tests, where

caused by weakness or inaccuracy of parts, or by defective materials or workmanship of any kind whatsoever.

- .9 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

- .10 Manufacturer's Field Services:

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

### **3.10 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 Luminaires shall be protected from dust and debris during construction. Reflectors, housings and lenses shall be protected from fingerprints during installation and adjustment. Cleaning of lenses and reflectors shall be carried out as per the manufacturer's recommended practices. On completion of this project, the Contractor shall remove all debris and leave the site neat and tidy. Equipment shall be checked for proper fitting and alignment, adjusted, cleaned, repainted where necessary, and left in first class condition.

**END OF SECTION**



**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for wire and box connectors (0-1000V).

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.2 No. 18.4-2015 (R2019), Hardware for the Support of Conduit, Tubing, and Cable.
  - .2 CSA C22.2 No. 65-2018, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):
- .3 National Electrical Manufacturers Association (NEMA).

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Mechanical pressure type wire connectors to: CSA C22.2 No. 65, with current carrying parts of copper or copper alloy, sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No. 65, with current carrying parts of copper or copper alloy sized to fit copper conductors #10 AWG or less.
- .3 Bushing stud connectors to: EEMAC and NEMA shall consist of:
  - .1 Connector body and stud clamp for stranded round copper conductors.
  - .2 Clamp for stranded round copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper conductors.

- .5 Sized for bars ampacity ratings.
- .4 Clamps or connectors for armoured cable, TECK cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CSA C22.2 No. 18.4

### **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.
    - .1 Joints required in branch circuit wiring #10 AWG and smaller shall be made using twist-on wire-nut connectors, #31, #33, or #35 as required. Twist-on wire-nut connectors shall be "plier-tightened", finger-tight is not acceptable. Insulating cap is to completely cover all conductors.
    - .2 Joints for all other wiring shall be made using compression type connectors. Insulation shall consist of a first layer of compound tape followed by a layer of vinyl electrical tape. Insulating tapes shall overlap successive wraps by a minimum of 50%.
  - .2 Install fixture type splice connectors and tighten to CSA C22.2 No. 65. Replace insulating cap.
  - .3 Install bushing stud connectors in accordance with EEMAC or NEMA.
- .2 All connections shall be made electrically and mechanically secure. The sizes of connectors shall be according to manufacturer's recommendations for each wire size and combination of wires.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for wire and cables (0-1000V).

### **1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.
- .3 Section 26 05 20 – Wire and Box Connectors (0-1000V).
- .4 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .5 Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.
- .6 Section 33 71 73.02 – Underground Electrical Service.

### **1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2021, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No. 38-2018, Thermoset-Insulated Wires and Cables.
  - .3 CSA C22.2 No. 51-2014 (R2018), Armoured Cables.
  - .4 CSA C22.2 No. 131-2017, Type TECK 90 Cable.

### **1.4 ACTION AND INFORMATIONAL SUBMITALLS**

- .1 Provide product data in accordance with Section 01 11 00 – General Requirements.

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

## **PART 2 PRODUCTS**

### **2.1 BUILDING WIRES**

- .1 Wire and cable to: to CSA C22.2 No. 38.
- .2 Conductors: stranded for #10 AWG and larger. Minimum size: #12 AWG for circuits exceeding 50 volts to ground.
- .3 Conductors of soft drawn copper of 98% conductivity, rated at 600 volts unless otherwise indicated, with RW90 insulation of chemically cross-linked thermosetting polyethylene (XLPE) material rated accordingly.
- .4 Neutral conductor insulated for 600V shall be continuous with no fuses, switches, or breaks of any kind. The neutral conductor for 120V receptacle circuits shall be #10 AWG for common neutral application. Where separate neutrals are installed for each circuit, the neutral shall match the current carrying capacity of the supply conductor.
- .5 Minimum bond wire is to be based upon Table 16A of the CSA C22.1. In no instance shall the bonding conductor installed for any systems be smaller than #12 AWG.

- .6 Wiring for specialized systems such as fire alarm and public address, structured cabling, Multi-media, etc. Shall be indicated in other sections or on drawings shall be indicated in other sections or on drawings.

- .7 Conductor Insulation shall be colour coded as follows:

Phase A	Red
Phase B	Black
Phase C	Blue
Neutral	White/Grey
Ground	Green
Bond	Green

All phase conductors up to and including #1 AWG shall have appropriate coloured insulation.

Neutral, ground and/or bond wires shall have appropriate coloured insulation on all sizes up to and/or including #3/0 AWG. Approved colour coded tapes in lieu of coloured insulation may be used on sizes other than indicated above minimum 30.5 mm of tape.

- .1 Isolated ground – Green with Yellow stripe.
- .2 Where extra colours are required for three way switches, they shall be Yellow
- .8 Grounding and bonding conductors sized up to and including #10AWG, are to have green colour RW90 X-link insulation. Type TW75 complete with green coloured insulation if acceptable for all sizes #8 AWG and larger.
- .9 The voltage drop in no case shall exceed 3% of the line volts for 15A, 120V branch circuits. The following table shall be used:

Branch Circuit Run from Panel to Load including Vertical Drops	Branch Circuit Conductor Size	Dedicated Neutral Size	Common Neutral Size	Bond Wire Size
24.4 M	#12	#12	#10	#12
24.5 M – 38.1 M	#10	#10	#8	#12
38.2 M – 56.4 M	#8	#8	#6	#10

- .10 Oversized #10 AWG branch circuit wiring conductors to be extended to outlet box of device they feed. Oversized #8 AWG branch circuit wiring conductors to be extended from panelboard to junction box located on wall or ceiling directly above receptacles. #8 AWG wire to be reduced to #10 AWG for vertical portion of drop only.
- .11 Voltage drop calculation: distance is measured to the last device along the conductor run.

## 2.2 TECK CABLE

- .1 Cable: to CSA C22.2 No. 131.
- .2 Conductors:
- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
- .1 Chemically cross-linked polyethylene XLPE, rated 600V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride material.

- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 1500 mm centers.
  - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
  - .1 Watertight, approved for TECK cable.

## **2.3 ARMoured CABLES**

- .1 Cable: to CSA C22.2 No. 51.
- .2 Conductors: insulated, copper, size as indicated.
- .3 Type: AC90.
- .4 Armour: interlocking type fabricated from galvanized steel strip.
- .5 Connectors: Steel set-screw with anti-short bushing.

## **2.4 CLASS 2 WIRING**

- .1 All low voltage communications and control wiring associated systems shall be secured directly to the structure utilizing adjustable type cable supports.
- .2 Cables shall be tie-wrapped neatly and installed in accordance with CSA C22.1 rules 60-312/16.220/12.010/2.128 and shall be FT4 rated.
- .3 Unless otherwise noted, mechanical controls wiring methods are to be similar to the voice/data structured cabling system.
- .4 The installation of "surface" wiring on walls or in open (non-enclosed) type ceilings, shall always be in EMT type conduit complete with associated "steel" type connectors and couplings.
- .5 EMT conduits are to be extended to within 750 mm of all various control devices associated with the operation of any given piece of mechanical equipment or device they might feed.
- .6 Unless specifically indicated otherwise, liquid tight flexible metal conduit complete with matching liquid tight type connectors are to be used for "final" connection between end of EMT conduit and applicable control device. A junction or pull box may also be utilized to make the transition.
- .7 EMT type conduit "wall-stub" complete with flush installed device box shall be located in all partitions to accommodate wiring between the device and the accessible ceiling space.
- .8 EMT connectors complete with nylon insulated throat or threaded type bushing shall be installed on end of EMT stub where it protrudes through wall "above", and within finish accessible type ceilings. EMT plastic end cap bushings that are CSA approved may also be used.
- .9 All EMT conduit stubs are to be "bonded" to ground as required by CSA C22.1.

## **PART 3 EXECUTION**

### **3.1 GENERAL CABLE INSTALLATION**

- .1 Install cables in trenches in accordance with Section 33 71 73.02 – Underground Electrical Service.
- .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors (0-1000V).
- .3 Cable Colour Coding: to Section 26 05 00 – Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .7 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### **3.2 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
  - .2 In underground ducts in accordance with Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.
- .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors (0-1000V).
- .3 The tie-wrapping of the neutral conductor with its respective phase conditions is to be made at the closet point of entry “within” all panelboards, pull boxes, junction boxes and outlet boxes, etc.
- .4 All branch circuits which do not have neutral conductors, are to have their respective phase conductors tie-wrapped together in accordance with previously described methods.

### **3.3 INSTALLATION OF TECK CABLE**

- .1 Install cables, securely supported by straps and/or hangers.
  - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors (0-1000V).

### **3.4 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors (0-1000V).

- .3 Fixture drops are to run from the junction box in the respective room and not to fixtures in other rooms. Fixture drops shall be from the side of the outlet boxes and not through the coverplate. Maximum of four fixture drops from any single junction box. AC 90 cables shall be secured within one foot of the junction boxes.
- .4 All types of "armoured" cables are to be installed concealed, parallel and perpendicular to building lines and shall be adequately secured to the building structure at not less than 1500 mm intervals or as otherwise indicated, in such manner as to ensure they are protected from potential types of mechanical damage occurring. Install independent supports for cabling in ceiling spaces and do not use those of other trades. Do not secure cables to mechanical systems piping, ducts, or suspended ceiling support wires. The laying of "un-supported" cables atop ceiling grids is strictly prohibited.
- .5 The grouping together of cables to form a "bundle" for securing purposes is acceptable provided:
  - .1 In addition to securing single cables at 1500 mm intervals, the installation of multiple or bundled cables shall be secured with additional support at the mid-point (ie. 750 mm) between the main supports.
  - .2 The minimum size conductors to be used for the wiring AC branch circuits of voltages rated 120 volts and larger shall be #12 AWG.
  - .3 Grouping of cables shall be limited to a maximum of eight (8) current carrying conductors (including neutrals). Examples:
    - .1 Maximum of two runs of #12/4C cables.
    - .2 Maximum of two runs of #12/3C cables and one run of #12/2C cables.
    - .3 Maximum of four runs of #12/2 conductor cables, each including a separate, dedicated branch circuit neutral conductor.
- .6 All flexible conduit or AC90 fixture feeds shall originate from the side of the outlet box and not from the box cover. Where 3 or 4 drops extended from one outlet, the box shall be a minimum 120 mm square. There shall be no more than 4 drops from any one box. All flex or AC90 cables used for fixture drops are to be secured with its own separate fixture drop originating from a junction box within that room.
- .7 AC90 and/or other types of systems pliable cables are not to be installed on exposed walls and/or ceilings without the benefit of conduit /raceway. This applies to all systems, including control wiring.
- .8 Install and secure surface cables directly to underside of metal decking and/or ceiling slabs where located in concealed ceiling spaces.
- .9 All cables are to be secured to concrete, concrete block, brick, metal docking/siding, with nylon type inserts complete with self tapping metal screws.
- .10 Pliable type cables are to be secured to building structure at 1200 mm intervals and tie-wrapped together at mid-point between each structure support.

### **3.5 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for primary grounding system.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Institute of Electrical and Electronics Engineers (IEEE):
  - .1 IEEE 837-2014, Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2021, Canadian Electrical Code, Part 1 (25<sup>th</sup> Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No. 0.4-2017, Bonding of Electrical Equipment.

**1.4 ACTION AND INFORMATIONAL SUBMITALLS**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, physical size, finish and limitations.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.
- .2 Conductors: bare, stranded, soft annealed copper wire, size as indicated for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.
- .3 Conductors: PVC insulated coloured green, stranded, soft annealed copper wire, size #4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- .4 Accessories: non-corroding, necessary for complete grounding system, including:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.



- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.
- .5 Wire connectors: compression, sized to fit copper conductors, as follows:
  - .1 Ground loop connector for copper cables. Acceptable manufactures:
    - .1 Burndy.
    - .2 Erico.
    - .3 Thomas & Betts.
  - .2 Compression ground rod to loop connector:
    - .1 Burndy.
    - .2 Erico.
    - .3 Thomas & Betts.
  - .3 Compression top connector for copper ground conductors:
    - .1 Burndy.
    - .2 Erico.
    - .3 Thomas & Betts.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with CSA C22.1, CSA C22.2 No. 0.4 and requirements of local authority having jurisdiction.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes, structural steel work, using compression connectors to IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Use #2/0 AWG bare copper cable for main ground bus connection to grounding rods.
- .7 The main incoming ground conductor is run to the main electrical panelboard and then to the wall mounted ground bus.

### **3.2 ELECTRODE INSTALLATION**

- .1 Install ground rod electrodes. Make grounding connections to equipment.
- .2 Install ground rod electrodes at location indicated on site plan.
- .3 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical building equipment including:

- .1 Metallic water main.
- .2 Non-current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang operated switches and fuse cut-out bases.
- .3 Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- .4 Meter and relay cases.
- .5 Any exposed building metal, within or forming part of station enclosure.
- .6 Outdoor lighting.
- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.
- .3 Connect metallic piping (water, oil, propane, natural gas, etc.) inside building to main ground bus at several locations, including each service location within building. Make connections to metallic water pipes outside building to assist in reduction of building ground resistance value.
  - .1 A #6 AWG insulated copper cable shall be run from the main electrical room ground bus to all main metallic drainage, water and sprinkler piping.

### **3.4 NEUTRAL GROUNDING**

- .1 Connect transformer neutral and distribution neutral together using insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.
- .2 Interconnect electrodes and neutrals at each grounding installation.
- .3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.
- .4 Ground transformer with continuous conductor from ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

### **3.5 PAD MOUNTED TRANSFORMER GROUNDING**

- .1 Drive ground rods around each pad on which transformers are installed on and interconnect transformer, system neutral and ground rods.

### **3.6 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.
- .3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.

- .4 Perform test and submit result and inspection certificate to Consultant before energizing electrical system.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for secondary grounding system.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Institute of Electrical and Electronics Engineers (IEEE):
  - .1 IEEE 837-2014, Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA):
  - .1 CSA C22.1-2021, Canadian Electrical Code, Part 1 (25<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .3 Telecommunications Industry Association (TIA):
  - .1 TIA-607-D (2019), Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

**1.4 ACTION AND INFORMATIONAL SUBMITALLS**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, physical size, finish and limitations

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of all 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 as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

## **PART 2 PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as indicated as required 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 diameter by 3 m long.
- .4 Plate electrodes: copper, surface area 0.2 m<sup>2</sup>, minimum 1.6 mm thick.
- .5 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .6 Insulated grounding conductors: green, type RW90.
- .7 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .8 Wire connectors: compression, sized to fit copper conductors.
- .9 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run bond 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 permanent mechanical connectors or inspectable wrought copper compression connectors to IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.

- .7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor to outdoor lighting standards.
- .9 All electrical connections to take a place on ground bus bars with compression connectors, suitable for terminating copper conductors.
  - .1 Copper one hole, short barrel type lugs for all sizes up to #6 AWG.
  - .2 Copper two hole, long barrel type lugs for all sizes #4 AWG and larger.
  - .3 To be bolted to bus bar via tapped threaded hole complete with accompanying flat and lock washers.
  - .4 Use "Burndy" type "ground to bus" connectors series "GB" or "GC" or approved equals, where "fed through" type terminations to bus bars are required for either single or parallel connections
- .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 provide non-metallic entry plate at load end.
- .13 Bond secondary service pedestals.
- .14 All bond wires are to be twisted together with a twist-on wire-nut connector and then placed in the rear of the outlet box in such a manner as to minimize obstructions.
- .15 All cables, feeder, and branch circuit conductors installed in conduit are to be complete with a separate minimum size #12 solid AWG copper bond wire sized in accordance with CSA C22.1 Table 16A.

### **3.2 EQUIPMENT GROUNDING**

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

### **3.3 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communications equipment room to ground bus with individual bare stranded copper connections, size as indicated.

### **3.4 COMMUNICATION SYSTEMS**

- .1 Install bonding connections for telecommunications and security systems to CSA C22.1 as follows:

- .1      Telephones: make telephone grounding system in accordance with telephone company's requirements and TIA 607.
- .2      All incomplete sections of conduit raceway shall be bonded to ground to CSA C22.1 rule 10.508.

**3.5            FIELD QUALITY CONTROL**

- .1      Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2      Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant 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**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures of hangers and supports for electrical equipment and systems.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Conditions.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

**PART 2 PRODUCTS**

**2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 mm square, 2.5 mm thick, surface mounted or suspended.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Secure all equipment in a manner so as not to distort or cause undue stress on any components.
- .2 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .3 Secure equipment to poured concrete with expandable inserts.
- .4 Toggle bolts shall not be used to support any equipment, including light fixtures from any plasterboard or drywall type construction.
- .5 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.
- .6 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .7 Fasten exposed conduit or cables to building construction or support system using straps:
  - .1 One-hole steel straps to secure surface conduits and cables 53 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 53 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .8 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.



- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .9 For surface mounting of two or more conduits use channels at 1500 mm on centre spacing.
- .10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .12 Do not use ty-wraps for supporting purposes. They may only be utilized to secure various systems wiring in place but in no instance are they to be used as a substitute for approved type metal straps, clamps, etc.
- .13 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .14 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Consultant.
- .15 Do not support any electrical conduits, wire or equipment from ceiling system support cables. Ceiling systems support cables may be utilized to marshal AC90 drops to fixtures.
- .16 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .17 Use channels where required to support electrical equipment where there is no wall support.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials, components and installation procedures for splitters, junction, pull boxes, and cabinets.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Conditions.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2021, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

**1.4 ACTION AND INFORMATIONAL SUBMITALLS**

- .1 Submit shop drawings and product data for cabinets in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

**PART 2 PRODUCTS**

**2.1 JUNCTION AND PULL BOXES**

- .1 Construction: sheet metal with all welded steel corners and screw-on flat covers for surface mounting.
- .2 Where larger than standard boxes use:
  - .1 Type D for boxes up to 305 mm square; and
  - .2 Type C for boxes larger than 305 mm square.
- .3 All flush installed boxes shall be Type D. Covers for flush mounted pull boxes shall extend a minimum of 25 mm all around.
- .4 Concealed junction boxes (within ceiling space) shall not be smaller than 102 mm square.

## **2.2 CABINETS**

- .1 Construction: sheet steel with all welded steel corners, hinged door, handle, latch, lock, two (2) keys and catch.
- .2 Type E Empty: surface return flange, flush overlapping sides, for surface mounting.

## **PART 3 EXECUTION**

### **3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations and secure them adequately to the building structure. Pull boxes installed in the middle of conduit runs without backing are not acceptable.
- .2 The location of junction and/or pull boxes in suspended ceiling spaces, e.g. drywall, T-Bar, etc., is not to be greater than 750 mm above the finished ceiling and must be easily accessible.
- .3 All suspended junction, pull and outlet boxes shall be supported with minimum size 9.5 mm threaded rods, nuts and flat washers. Threaded rods shall be secured to boxes with one flat washer and nut installed on both sides of box. One rod required for all boxes sized up to and including 120 mm square. Two rods required for boxes larger than 120 mm square, up to and including 204 mm square. A minimum of four rods required for all boxes larger than 204 mm square.
- .4 Mount cabinets with top not higher than 2 m above finished floor.
- .5 Install terminal block as indicated in Type T cabinets.
- .6 Only main junction and pull boxes are indicated. Install additional pull boxes as not to exceed 30 m of conduit run between pull boxes, and as required by CSA C22.1.

### **3.2 IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Identification labels: Install size 2, indicating system name, voltage and phase.
- .3 All junction and pull boxes coverplates are to be colour coded.
- .4 Concealed junction and pull boxes installed above ceilings or behind walls, are to have their locations identified on room sides of access opening frames with properly coloured coded identification discs.
- .5 Coverplates for junction and pull boxes located above finished ceilings housing branch circuits shall have each branch circuit number neatly identified on plate. Felt marker may be used for this purpose.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures of outlet boxes, floor boxes, conduit boxes and fittings for electrical equipment and systems.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2021, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

**PART 2 PRODUCTS**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Ganged boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

**2.2 GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 mm x 50 mm x 50 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.
- .6 Extension and tile rings for flush mounting devices in finished tile 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-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.5 CONDUIT BOXES**

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.
- .2 PVC FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

## **2.6 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

# **PART 3 EXECUTION**

## **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Boxes shall not be mounted back to back in walls, but separated by a minimum of 305 mm, to prevent noise transmission.
- .7 No outlet or junction box may be installed more than 750 mm above a finished ceiling.
- .8 All suspended boxes are to be supported with minimum size 6.5 mm threaded rod.
- .9 All flexible conduit fixture feeds shall originate from the side of the outlet box and not from the box cover.
- .10 Flush installed 102 mm square or a 120 mm square boxes being used as a junction or pull box that requires a blank metal coverplate, shall have an appropriately sized, one or two gang plaster ring installed on same. This permits the use of a standard, one or two gang (blank) coverplate to be used, and avoids the necessity of acquiring an oversized, custom made coverplate.
- .11 Tile extension rings are not to be used on boxes that have not been flush installed. They are not intended, and not acceptable for surface type application.

**3.2 IDENTIFICATION**

- .1 All outlet boxes shall be colour coded as per the colour coding legend for conduits and cables. Refer to Specification Section 26 05 00 – Common Work Results for Electrical. Outlet boxes are to be coloured only on the inside.
- .2 Concealed boxes installed above drywall ceilings or behind walls, are to have their locations identified on room sides of access opening frames with properly colour coded identification discs

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures of conduits, conduit fastenings and conduit fittings for electrical equipment and systems.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2021, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No. 18.3-2012 (R2017), Conduit, Tubing, and Cable Fittings.
  - .3 CSA C22.2 No. 18.4-2015 (R2019), Hardware for the Support of Conduit, Tubing, and Cable.
  - .4 CSA C22.2 No. 45.1-2007 (R2017), Electrical Rigid Metal Conduit - Steel.
  - .5 CSA C22.2 No. 56-2017, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .6 CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing.
  - .7 CSA C22.2 No. 211.2-2006 (R2021), Rigid PVC (Unplasticized) Conduit.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

**PART 2 PRODUCTS**

**2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45.1, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid PVC Conduit: to CSA C22.2 No. 211.2
- .4 Flexible metal conduit: to CSA C22.2 No. 56, aluminum and liquid-tight flexible metal.

**2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 53 mm and smaller. Two hole steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1500 mm on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: to CSA C22.2 No. 18.3 and CSA C22.2 No. 18.4, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degree bends are required for 27 mm and larger conduits.
- .3 Couplings and connectors EMT shall be set-screw type or watertight. Connectors for conduits sizes 41 mm and large shall be complete with threaded plastic bushings. Connectors for conduits sizes smaller than 41 mm shall be complete with insulated throats
- .4 Connectors for flexible conduit and armoured cable shall be set-screw steel. Locknuts shall be case hardened.
- .5 Connectors for liquid tight flexible conduit shall be watertight, compression type galvanized steel or aluminum. Locknuts shall be case hardened. Dry type connectors may be used in dry indoor areas not exposed to liquids or moisture, if approved for use.

## **2.4 FISH CORD**

- .1 Polypropylene.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms, and in unfinished areas.
- .3 Install conduits to avoid proximity to steam and hot water pipes by 150 mm.
- .4 Conduits shall run through ceiling spaces and down in walls. No conduit shall run in floor slabs unless specifically indicated.
- .5 Use electrical metal tubing (EMT) for all work, unless otherwise indicated, for panelboard feeders, branch circuit wiring, etc., and where not installed underground.
- .6 All conduits shall be securely held in place by means of approved supports and in accordance with CSA C22.1. All EMT conduit straps shall be steel, cast straps are not acceptable.
- .7 Securely fasten EMT in place within 900 mm of each outlet box, junction box, cabinet, coupling or fitting, and the maximum spacing between supports shall be as follows:
  - .1 1.5 m for 16 mm and 21 mm EMT.
  - .2 2.1m for 27 mm and 35 mm EMT.
  - .3 3 m for 41 mm EMT and larger
- .8 Rigid PVC conduits shall be used in all poured concrete construction.
- .9 Use rigid PVC conduit underground.
- .10 Use flexible metal conduit for connections between lighting fixtures and their respective junction boxes, and where rigid EMT conduit cannot be used, such as in cabinet work.
- .11 Use liquid tight flexible metal conduit for connections transformers, motors and equipment in both wet and dry areas.



- .12 Conduit shall not pass through structural members without the permission of the Consultant.
- .13 Conduits shall be continuous, and shall be made electrically and mechanically secure throughout.
- .14 Minimum conduit size for lighting and power circuits: 16 mm.
- .15 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .16 Mechanically bend steel conduit over 21 mm diameter.
- .17 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .18 Install fish cord in empty conduits.
- .19 Run three 27 mm spare conduits up to ceiling space from each flush panel. Terminate these conduits in 152 mm x 152 mm x 102 mm junction boxes in ceiling space.
- .20 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .21 Dry conduits out before installing wire.

### **3.2 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 or surface 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.

### **3.3 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.

### **3.4 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.
- .3 Install a minimum 600 mm below finished grade, unless indicated otherwise.

### **3.5 COUPLINGS AND CONNECTORS**

- .1 Threaded couplings shall be used for all rigid steel threaded conduit joints. All joints in or below concrete slabs shall be thoroughly red leaded and screwed tight. No exposed threads shall be left, i.e., running thread couplings are not approved. Ericson couplings are approved.
- .2 Rigid steel threaded conduit shall connect to boxes and cabinets with the use of two case hardened steel locknuts and insulated bushing. Painted area at locknut connections shall be scraped clean, and locknuts screwed tight to ensure ground continuity.

- .3 EMT couplings shall be securely tightened.
- .4 Connectors for EMT, liquid tight and flexible conduit or cable shall terminate at boxes and cabinets with one case hardened locknut. Painted area shall be scraped clean, and locknut screwed tight to ensure ground continuity.
- .5 Watertight connectors and couplings shall be used for exposed vertical runs of EMT. Set-screws are not acceptable for exposed vertical runs.
- .6 Couplings and connectors for rigid PVC shall be cleaned with solvent and joined with cement CSA approved for the purpose.

**3.6 CONDUIT FITTINGS**

- .1 Install conduit fittings where required. Secure conduit in fittings and secure conduit to structure within 305 mm of fitting.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Installation procedures of cables in trenches and in ducts.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA).

**PART 2 PRODUCTS**

**2.1 CABLE PROTECTION**

- .1 38 mm x 140 mm planks, pressure treated with water repellent preservative.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare terminals: minimum three spare terminals on each lug block sized less than 400 A.

**2.2 MARKERS**

- .1 Warning tape: 78 mm wide with words "CAUTION ELECTRIC LINES BURIED BELOW" or "CAUTION COMMUNICATIONS LINES BURIED BELOW". Warning tape shall be made of non-biodegradable polyethylene film.

**PART 3 EXECUTION**

**3.1 DIRECT BURIAL OF CABLES**

- .1 After sand bed is in place, lay cables maintaining 78 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.
- .2 Provide offsets for thermal action and minor earth movements. Offset cables 78 mm for each 61 m run, maintaining minimum cable separation and bending radius requirements.
- .3 Underground cable splices are not acceptable.
- .4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .5 Cable Separation:
  - .1 Maintain 78 mm minimum separation between cables of different circuits.
  - .2 Maintain 305 mm horizontal separation between low and high voltage cables.

- .3 When low voltage cables cross high voltage cables maintain 305 mm vertical separation with low voltage cables in upper position.
- .4 At crossover, maintain 78 mm minimum vertical separation between low voltage cables and 152 mm between high voltage cables.
- .5 Maintain 305 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
- .6 Install treated planks on lower cables 610 mm in each direction at crossings.
- .6 After sand protective cover is in place, install continuous row of overlapping pressure treated planks, interlocking cable blocks as indicated to cover length of run.

### **3.2 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 multi-conductor 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.
- .7 Install in each empty duct, 6 mm stranded polypropylene pull rope continuous throughout with 1000 mm spare rope at each end.
- .8 Cap all spare ducts.

### **3.3 MARKERS**

- .1 Mark cables continuous along cable/duct runs with warning tape.

### **3.4 FIELD QUALITY CONTROL**

- .1 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .2 Check phase rotation and identify each phase conductor of each feeder.
- .3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .4 Tests:
  - .1 After installing cable but before terminating, perform insulation resistance test with 1000 V megger on each phase.

- .2 Check insulation resistance after each termination to ensure that cable system is ready to be energized.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

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

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.
- .3 Section 06 10 00 – Rough Carpentry.
- .4 Section 26 28 16.02 – Moulded Case Circuit Breakers.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.2 No. 29-2015 (R2019), Panelboards and Enclosed Panelboards.

**1.4 ACTION AND INFORMATIONAL SUBMITALLS**

- .1 Submit shop drawings in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.
- .2 Shop drawings:
  - .1 Indicate 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 V bus and breakers rated for 22 kA (symmetrical) interrupting capacity or as indicated.
- .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 Fitted with lock type doors and two (2) keys for each panelboard and key panelboards alike.
- .6 Copper bus or tin plated aluminium with neutral of same ampere rating as mains.
- .7 Mains: suitable for bolt-on breakers.
- .8 Panels shall be complete with integral TVSS protection.

- .9 Provide bonding terminal strips in panelboards, factory installed. Where more than one bonding terminal strip is present in any one panel, both shall be hard-wired together using identical size bonding conductor as one accompanying the panel feeder conductors.
- .10 Trim with concealed front bolts and hinges.
- .11 Trim and door finish: baked grey enamel.
- .12 Surface mounted panel shall be complete with sprinkler-proof hoods.
- .13 Panelboards shall be a minimum of 508mm wide.
- .14 Panelboard should be service entrance rated.

## **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 Owner's Representative.
- .5 Lock-on devices for emergency lights, exit lights and night light circuits.
- .6 Main breaker within panel P to be 200A 100% rated .

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit. Directory shall be protected by a clear plastic cover.

## **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 for Electrical or as indicated.

- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

### **3.2 FIELD QUALITY CONTROL**

- .1 Test each branch breaker to verify that it controls the load indicated on the drawing and panel directory.

**END OF SECTION**



**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for switches, receptacles, wiring devices, and cover plates.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.
- .3 Section 26 28 20 – Ground Fault Circuit Interrupters.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2018, Canadian Electrical Code, Part 1 (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No. 42-10 (R2020), General Use Receptacles, Attachment Plugs and Similar Devices.
  - .3 CSA C22.2 No. 42.1-2013 (R2017), Cover Plates for Flush-Mounted Wiring Devices.
  - .4 CSA C22.2 No. 55-2015, Special Use Switches.
  - .5 CSA C22.2 No. 111-2018, General-Use Snap Switches.
- .2 National Electrical Manufacturers Association (NEMA).

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.

**PART 2 PRODUCTS**

**2.1 SWITCHES**

- .1 15 A and 20 A, 120 V, single pole, and three-way switches to: CSA C22.2 No. 55 and CSA C22.2 No. 111.
- .2 Manually-operated general purpose AC switches fully rated for lighting loads, and up to 80% of rated capacity of motor loads with the following features:
  - .1 Terminal holes approved for #10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Impact resistant nylon face and thermoplastic back body.
  - .4 Suitable for back and side wiring.
  - .5 White toggle.
- .3 Manually-operated general purpose AC switches c/w dual type occupancy sensor, fully rated for lighting loads, and up to 80% of rated capacity of motor loads with the following features:
  - .1 Terminal holes approved for #10 AWG wire.

- .2 Impact resistant nylon face and thermoplastic back body.
- .3 Suitable for back and side wiring.
- .4 Dual type occupancy sensing incorporating both PIR and ultrasonic technologies.
- .5 White body and face plate.
- .6 Programmed to operate in vacancy mode.
- .4 Three-way and four-way switches of same standard quality.
- .5 Other switches with ampacity, voltage, and features as indicated.
- .6 Switches of one manufacturer throughout project.
- .7 Shall be heavy-duty specification grade.

## **2.2 RECEPTACLES**

- .1 15 A and 20 A, 125 V, U-ground decora style, duplex receptacles (CSA type 5-15R and 5-20R respectively): to CSA C22.2 No. 42 with following features:
  - .1 Impact resistant nylon face and thermoplastic back body.
  - .2 Suitable for #10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Receptacles with two type A USB charging ports, integrated, as indicated.
- .3 Weather-resistant, as indicated.
- .4 Ground fault circuit interrupting (GFCI) type receptacles: in accordance with Section 26 28 20 – Ground Fault Circuit Interrupters.
- .5 Other receptacles with ampacity and voltage as indicated.
- .6 Receptacles of one manufacturer throughout project.
- .7 Shall be heavy-duty specification grade.

## **2.3 DUAL TYPE CEILING MOUNTED OCCUPANCY SENSORS**

- .1 Automatically operated, ceiling mounted occupancy sensors to come complete with the following features:
  - .1 Dual type detection incorporating both PIR and ultrasonic technologies.
  - .2 Low voltage 0-10V input.
  - .3 To include all line voltage power packs required for switching.
  - .4 White finish.
  - .5 Low profile mounting.

## **2.4 COVER PLATES**

- .1 Cover plates for wiring devices: to CSA C22.2 No. 42.1.
  - .1 Impact resistant nylon, colour to match wiring device, for wiring devices mounted in flush-mounted outlet box.

- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 Weatherproof while-in-use cover for exterior wiring devices:
  - .1 Extra-duty, die-cast aluminum construction, padlockable, NEMA 3R rated, to comply with CSA C22.1.
- .5 Cover plates from one manufacturer throughout project.

## **2.5 EXTERIOR LIGHTING TIME CLOCK**

- .1 Integral system clock shall provide scheduling capabilities.
  - .1 The clock capability shall support the time-based energy saving requirements of applicable local energy codes.
  - .2 The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for the clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
  - .3 The clock capability shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:
    - .1 Scheduled ON / OFF.
    - .2 Manual ON / Scheduled OFF.
    - .3 Astro ON / OFF (or Photo ON / OFF).
    - .4 Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF).
  - .4 The clock capability shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.
  - .5 Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

## **2.6 IDENTIFICATION**

- .1 All receptacles are to each have individual lamicoid nameplate installed on cover plate directly above receptacle, with the following information: designated panel numbers and/or letters, circuit no(s) and any other information as may be deemed necessary
- .2 Provide size 1 nameplate in accordance with Section 26 05 00 – Common Work Results for Electrical.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with toggle in "UP" position when switch closed.

- .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .3 Mount toggle switches at height in accordance with Section 26 05 00 – Common Work Results for Electrical or as indicated otherwise.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height in accordance with Section 26 05 00 – Common Work Results for Electrical or as indicated otherwise.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 All receptacles installed out in the exterior shall be weather-resistant complete with while-in-use cover.
  - .5 All receptacles located on exterior of building are to be mounted in flush, weatherproof while-in-use enclosure incorporating a recessed box and cover plate, fed from ground fault circuit interrupt breakers from their respective panel
- .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.
  - .4 Install weatherproof while-in-use cover plates for all receptacles exposed to the weather.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Materials for moulded-case circuit breakers.

### **1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Result for Electrical.
- .3 Section 26 24 16 – Panelboards Breaker Type.
- .4 Section 26 28 20 – Ground Fault Circuit Interrupters.

### **1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.2 No. 5-2016 (R2021), Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements: 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 ampacity of 100 A and over or with interrupting capacity of 22 kA symmetrical (rms) and over at system voltage.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- .1 Breakers shall be compatible with panelboards specified in Section 26 24 16 – Panelboards Breaker Type, and shall meet the kA ratings as indicated.

### **2.2 BREAKERS GENERAL**

- .1 Moulded-case circuit breakers, and accessory high-fault protectors: to CSA C22.2 No. 5.
- .2 Ground-fault circuit-interrupter breakers: refer to Section 26 28 20 – Ground Fault Circuit Interrupters.
- .3 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 °C ambient.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

- .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Common-trip breakers: with single handle for multi-pole applications. Tie-bars are not permitted.
- .6 The use of plug-in moulded-case circuit breakers is not permitted.
- .7 The use of "mini" type circuit breakers is not permitted.
- .8 Extension handles are to be provided for all breakers rated 225 A and larger.

## **2.3 THERMAL MAGNETIC BREAKERS**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

## **2.4 SOLID STATE TRIP BREAKERS**

- .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, instantaneous, tripping for phase, and ground fault short circuit protection.
- .2 Main breaker for service entrance board shall be solid-state, rated for 100% current carrying capacity.
- .3 All breakers 400 A and large shall be solid state.

## **2.5 OPTIONAL FEATURES**

- .1 Included, as indicated.
  - .1 Shunt trip.
  - .2 Auxiliary switch.
  - .3 Motor-operated mechanism.
  - .4 Under-voltage release.
  - .5 On-off locking device.
  - .6 Handle mechanism.

# **PART 3 EXECUTION**

## **3.1 INSTALLATION**

- .1 Install circuit breakers.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Equipment and installation procedures for ground fault circuit interrupters (GFCI).

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 27 26 – Wiring Devices.

**1.3 REFERENCES**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2018, Canadian Electrical Code, Part 1 (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No. 144.1-2016, Ground Fault Circuit-Interrupters.
- .2 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA PB 2.2-2014, Application Guide for Ground Fault Protection Devices for Equipment.

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CSA C22.2 No. 144 and NEMA PB 2.2.
- .2 Components comprising ground fault protective system to be of same manufacturer.

**2.2 BREAKER TYPE GROUND FAULT INTERRUPTER**

- .1 Single and two pole ground fault circuit interrupter for ampacity and voltage as indicated, complete with test and reset facilities.

**2.3 GROUND FAULT PROTECTOR UNIT**

- .1 Self-contained with 15 A and 20 A, 125 V circuit interrupter and duplex receptacle complete with:
  - .1 Solid state ground sensing device.
  - .2 Facility for testing and reset.
  - .3 Flush mounted with cover plate of matching colour.
  - .4 Shall be of same one manufacturer as receptacles in Section 26 27 26 – Wiring Devices.

- .5 Shall be heavy-duty specification grade.

## **2.4 EQUIPMENT IDENTIFICATION**

- .1 Provide identification for receptacles protected by GFCI circuit breakers and ground fault protector units.
  - .1 Decal labelled "GFCI Protected".

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install GFCI receptacles in accordance with CSA C22.1.
  - .1 All receptacles installed within 1.5 m of wash basins complete with drain pipe shall be protected by a ground fault circuit interrupter, Class A type.
  - .2 All receptacles installed out in the exterior shall be weather-resistant complete with while-in-use cover, refer to Section 26 27 26 – Wiring Devices.
- .2 Do not ground neutral on load side of ground fault relay.
- .3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.
- .4 Provide a separate neutral for each circuit with a ground fault protector unit.

**END OF SECTION**



## **PART 1 GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for lighting.

### **1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

### **1.3 REFERENCES**

- .1 American National Standards Institute (ANSI):
  - .1 ANSI C78.377-2017, American National Standard for Electric Lamps - Specifications for the Chromaticity of Solid-State Lighting Products
- .2 Illuminating Engineering Society (IES):
  - .1 IES LM-79-2019, Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.
  - .2 IES LM-80-2020, Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules.
- .3 United States of America, Federal Communications Commission (FCC):
  - .1 FCC 47 CFR, Part 15, Radio Frequency Devices.
  - .2 FCC 47 CFR, Part 18, Industrial, Scientific, and Medical Equipment.
- .4 Underwriters Laboratories of Canada (ULC) Standards:
- .5 Nation Research Council of Canada (NRCC):
  - .1 NBC-2015, National Building Code of Canada
- .6 Canadian Standards Association (CSA):
  - .1 CSA C22.2 No. 141-2015 (R2020), Emergency Lighting Equipment.

### **1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval review by Consultant.

## **PART 2 PRODUCTS**

### **2.1 LED LUMINAIRES AND DRIVERS**

- .1 High Efficiency - All Luminaries:
  - .1 Comply with IES LM-79.
  - .2 Comply with IES LM-80.

- .3 LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
- .4 LED luminaires shall deliver a minimum of 60 lumens per watt: LED's shall be "Bin No. 1" quality.
- .5 Drivers shall be solid state and accept 120 and 347 VAC at 60 Hz input, as required..
- .6 The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
- .7 LED color temperatures: to ANSI C78.377:
  - .1 2700K nominal, range: 2725K +/- 145K.
  - .2 3000K nominal, range: 3045K +/- 175K.
  - .3 3500K nominal, range: 3465K +/- 245K.
  - .4 4000K nominal, range: 3985K +/- 275K.
  - .5 4500K nominal, range: 4503K +/- 243K.
  - .6 5000K nominal, range: 5028K +/- 283K.
- .8 Luminaires shall have internal thermal protection.
- .9 Luminaires shall not draw power in the "OFF" state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
- .10 Color spatial uniformity shall be within .004 of CIE 1976 color space.
- .11 Color maintenance over rated life shall be within .007 of CIE 1976 color space.
- .12 Indoor luminaires shall have a minimum CRI of 85.
- .13 Luminaire manufacturers' shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management.
- .14 LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.
- .15 Luminaires shall be fully accessible from below ceiling plane for changing drivers, power.
- .2 Power Supplies and Drivers:
  - .1 Power Factor: 0.95 or higher.
  - .2 Maximum driver case temperature not to exceed driver manufacturer recommended in suite operation.
  - .3 Output Operating Frequency: 60Hz.
  - .4 Interference: EMI and RFI Compliant with FCC 47 CFR Part 15.
  - .5 Total Harmonic Distortion Rating: 20% maximum.
  - .6 Meet electrical and thermal conditions as described in IES LM-80 Section 5.0.
  - .7 Primary Current: Confirm primary current with Drawings.
  - .8 Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
  - .9 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.
  - .10 Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or CSA 3R enclosures as required.
- .3 Emergency Lighting Battery Drivers to CSA C22.2 No. 141 with the following features:
  - .1 Supply Voltage: 120VAC.

- .2 Operating time: Minimum 30 minutes.
- .3 Battery: Sealed, maintenance free.
- .4 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.

## **2.2 FINISHES**

- .1 Luminaire finish and construction to meet ULC listing and CSA certifications related to intended installation.

## **2.3 LUMINAIRES**

- .1 As indicated in Lighting Fixture Schedule.

# **PART 3 EXECUTION**

## **3.1 GENERAL**

- .1 All measurements indicated on lighting plans are approximate. Contractor is required to perform field measurements based on actual site conditions to develop complete orders and install systems per drawings and specifications. Verify all run length configurations and quantities. All continuous run lengths must be continuously illuminated, hairline seams only, unless otherwise noted.
- .2 Verify all voltages, lamp types, field measurements, etc as required.
- .3 Field verify all mounting conditions and provide all hardware necessary to complete installation for full system operation.
- .4 Verify the type of ceiling, coordinate with architectural and electrical drawings, prior to purchase of lighting fixtures.
- .5 See interior design drawings for fixture locations.
- .6 All lighting fixtures (supplied by the Contractor) shall be supplied with lamps, color filters, etc. and accessories as specified.
- .7 All lighting fixtures installed in architectural details and/or millwork details must be confirmed and installed per Consultant's recommended criteria (ie. aperture opening, visual cutoff angles, aiming angles, etc.).

## **3.2 INSTALLATION**

- .1 Locate and install luminaires as indicated. Install equipment in accordance with manufacturers' installation instructions.
- .2 Connect luminaires to lighting circuits as indicated.
- .3 Provide adequate support to suit ceiling system.
- .4 All remote power supplies shall be located at an accessible, ventilated location.
- .5 Comply with maximum do not exceed remote distance of power supplies per manufacturers' recommendation

### **3.3 LUMINAIRE SUPPORTS**

- .1 For suspended ceiling installations, luminaires shall be securely fastened to the ceiling framing member by means of clips listed and identified for use with the type of ceiling framing member(s) and luminaire(s).
- .2 For pole mounted installations, poles shall be 102mm x 102mm square 11 gauge steel poles, 4572 mm tall, with a minimum EPA (Effective Projected Area) rating of 10 at 160 km/h. Pole shall be mounted on a concrete base with a height of 458 mm above grade.

### **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 Coordinate location and mounting of fixtures with other services.

### **3.5 FIELD QUALITY CONTROL**

- .1 To test emergency battery drivers installed within fixtures complete the following: With all the remote fixtures installed, turn off the power source and measure the length of time until battery is disconnected from the load. Replace the battery if the time is less than 30 minutes.
- .2 Submit test results to Consultant.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for electric in-floor heating mats and associated devices.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.2 No. 130-16: Requirements for electrical resistance trace heating and heating device sets
- .2 Underwriters Laboratories (UL) Standards:
  - .1 UL 515 Standard for Electrical Resistance Trace Heating for Commercial Applications.
  - .2 UL 1042-2009, Standard for Electric Baseboard Heating Equipment.
- .3 National Fire Protection Agency: NFPA 70

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for convectors and thermostat controls and include product characteristics, performance criteria, physical size, finish and limitations.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 11 00 – General Requirements: Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for convectors for incorporation into manual.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 11 00 – General Requirements.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, corrugated cardboard, packaging material 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.

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

## **PART 2 PRODUCTS**

### **2.1 ELECTRIC IN-FLOOR ELECTRIC HEATING SYSTEMS**

- .1 General requirements for electric heating cables
  - .1 Electrical components devices and accessories: listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - .2 Source limitations: All system components to be sourced from a single manufacturer, under no circumstances are any components installed other than those supplied by cable manufacturer, to ensure system integrity and to meet warranty requirements.
- .2 Self-regulating, parallel-resistance heating cables shall meet the following requirements:
  - .1 Uniform consistent heating
  - .2 Custom, manually laid cable c/w manufacturer spacing mats.
  - .3 Installed to produce 12 watts per square foot of heat.
  - .4 Consistent wire spacing to reduce site irregularities and eliminate cold spots.
  - .5 240VAC Supply voltage.
  - .6 Compliance with: UL515, CSA 22.2 No.130-16.
  - .7 Element: Parallel No.14 AWG nickel-coated stranded copper bus wires.
  - .8 Electrical insulated inner jacket: Modified polyolefin
  - .9 Cable Cover: Tinned-copper braid with polyolefin outer jacket.
  - .10 Heating cable to have a self-regulating factor of at least 70 percent.
  - .11
- .3 Thermostat Control: For increased zone warming efficiency, sensing thermostat shall include:
  - .1 Line voltage 240V supply.
  - .2 Floor-sensor or thermos-coupler that ensures the power cycles once timer reaches temperature.
  - .3 Built-in GFCI protection.
  - .4 Standard polycarbonate lockable cover.
  - .5 Controllable temperature.

### **2.2 BASEBOARD HEATERS**

- .1 Heaters: to CSA C22.2 No. 46 and UL 1042, standard wattage density with connection box at both ends.
  - .1 Heater type 'A': Single phase, 120 V input, 300 W rated.
- .2 Element: stainless steel tubular heating element, locked to cabinet and supported at additional points throughout length to allow for linear expansion with non metallic supports.
- .3 Cabinet: to CSA C22.2 No.46 and UL 1042, pre-drilled back for securing to wall. Integral air diffusion reflector with wireway at bottom.

- .1 Front bottom inlet/front top outlet.
- .2 Construction: 22 gauge steel body, 20 gauge steel front panel, rounded upper corners.
- .3 Finish: epoxy/polyester powder coated paint, white colour.
- .4 Controls: Integral factory installed electronic thermostat to control heater.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- .1 Verify that floor surfaces to be covered with floor warming mat, ceramic tile, mosaics, pavers, trim units, or thresholds are sound and conform to good design/engineering practices and rigid with maximum deflection of L/360 distributed uniformly over the span
- .2 Concrete cured a minimum of twenty-eight (28) days with a saturated surface dry (SSD) condition, including an initial seven (7) day period of wet curing.
- .3 Concrete slab to have steel trowel or light broom finish when mat is installed by the thin-set method.
- .4 Clean and free of dirt, oil, grease, sealers, curing compounds, form oil, or loose plaster, paint, and scale.
- .5 All first-time installers shall confirm installation methods with manufacturer prior to install.

#### **3.2 SURFACE CONDITIONS**

- .1 Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- .2 Coordinate with other trades as needed to assure that proper substrata are provided to receive the work of this section.
  - .1 Horizontal surfaces: plumb within 1/4" in ten feet in all directions.
- .3 Condition of surfaces to receive warming mat.
  - .1 Verify that surfaces to receive mortar setting bed and amt are firm, dry clean and free from dust, wax, grease, sealers and all other contamination which may reduce or prevent adhesion.
  - .2 Verify that grounds, anchors, plugs, recess frames, bucks, electrical work, mechanical work, and similar items under the mat have been installed before proceeding with the installation of the mortar bed or mat.

#### **3.3 INSTALLATION**

- .1 Make power and control connections.
- .2 Install according to manufacturers instructions.
- .3 Where indicated on the drawings and elsewhere, as required provide a warming mat using one of the those listed on the "tested materials" list of the Underwriter's Laboratory (UL) or the Canadian Standards Association (CSA).

- .4 General:
  - .1 Comply with the pertinent provisions of the referenced standards, except as otherwise directed by the architect or engineer.
  - .2 Maintain minimum temperature limits and installation practices recommended by materials manufacturer.
  - .3 Do not install tile floors over membrane until the membrane has been tested and accepted. To confirm the proper power consumption of your mat, perform the resistance test. Ensure that the resistance reading is within the range of plus 10% to minus 5% of the resistance rating listed on the mat tag.
  - .4 To confirm that there is no short to ground in the mat, perform the insulation test. Mark test results on warranty card and ensure they match manufacturer's recorded information on the mat tag.
- .5 Electrician or qualified contractor to wire floor warming system to power source.
- .6 Apply coat of acrylic or latex modified thinset using ¼ inch square notched trowel to sub-floor. Roll the mat into the thinset material, using a grout float, smooth out all air bubbles or folds. Ensure bond between mat and thinset conforms to at least 80% coverage.
- .7 Lay out lead wires and install the thermostat sensor probe wire.
- .8 Install ceramic tile and/or marble according to section 9.

### **3.4 PROTECTION**

- .1 Protect finished installation. Close areas to other trades and traffic until tile being installed has set firmly. Keep traffic off horizontal Portland cement thick bed mortar installations for at least seventy-two hours (72).
- .2 Replace or restore work of other trades damaged or soiled by work under this section.

**END OF SECTION**



**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures of pathways for communications cabling.

**1.2 RELATED REQUIREMENTS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.
- .3 Section 26 05 28 – Grounding - Secondary.
- .4 Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.
- .5 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings
- .6 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .7 Section 33 65 76 – Direct Buried Underground Cable Ducts.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.1-2021, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

**1.4 SYSTEM DESCRIPTION**

- .1 Communications raceway system shall consist of conduits, junction & pull boxes, outlet boxes, sleeves and caps, fish wires and J-hooks and cable hangers as further described within the section of this specification.

**PART 2 PRODUCTS**

**2.1 MATERIAL**

- .1 Conduits: EMT type, in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Underground cable ducts: PVC type, in accordance with Section 33 65 76 – Direct Buried Underground Cable Ducts.
- .3 Junction boxes, cabinet type E and/or T, in accordance with Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.
- .4 Outlet boxes, conduit boxes and fittings: in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes, and Fittings.
- .5 Communication cable supports (Cable hooks aka J-hooks) shall:
  - .1 Provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables (Cat. 6 and Cat. 6A).

- .2 Have flared edges to prevent damage while installing cables.
- .3 Include a top latch to keep cable within the hook. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
- .4 Have an electro-galvanized finish and shall be rated for indoor use in non-corrosive environments.
- .6 Fish cord: polypropylene type.
- .7 Grounding: in accordance with Section 26 05 28 – Grounding - Secondary.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install empty raceway system, as indicated, including terminal cabinets, outlet boxes, conduits, sleeves and caps, fish wire, miscellaneous and positioning material to constitute a complete system.
- .2 Use rigid EMT conduit for installation of communications cables in exposed ceilings and walls.
- .3 Use rigid EMT conduit "stubs" for installation of communication cables in walls where accessible T-bar ceiling space is above.
- .4 Use cable hooks to support communication cables where installed in accessible ceiling space. Cable hooks:
  - .1 Shall not be supported by ceiling grid support wires.
  - .2 Shall be independently supported with wires attached to the structural ceiling (above floor deck) on one end and to the suspended ceiling grid on the other end. The prior is meant to carry the load, the latter is meant to act as a "sway control".
  - .3 Shall be sized to allow for a maximum of 25% capacity to facilitate future installation of cables.
  - .4 Shall be installed such that cable slack between supports is a minimum of 152 mm above ceilings.
  - .5 Shall be adequately provided to ensure communications cabling is a minimum of 152 mm away from light fixtures and power conduits.
  - .6 Shall be provided at every communications cabling change in direction.
- .5 Use rigid PVC conduit for installation of underground communications cables.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for direct buried underground cable ducts.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

**1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.2 No. 211.1-206 (R2016), Rigid Types EB1 and DB2.ES2 PVC Conduit.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

**1.5 QUALITY ASSURANCE**

- .1 Quality assurance submittals: submit following in accordance with Section 01 11 00 – General Requirements.
  - .1 Certificates: signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.
  - .2 Manufacturer's Instructions: for installation and special handling criteria, installation sequence and cleaning procedures.

**1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 11 00 – General Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management in accordance with 01 11 00 – General Requirements.

**PART 2 PRODUCTS**

**2.1 PVC DUCTS AND FITTINGS**

- .1 Rigid PVC duct: to CSA No. 211.1, type DB2/ES2, with moulded fittings, for direct burial.
  - .1 Nominal length: 6 m plus or minus 12 mm.

- .2 Rigid PVC split ducts.
- .3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.
- .4 Rigid PVC 90 degrees, 45 degrees bends and 5 degrees angle couplings as required.
- .5 Expansion joints every 30 m and as required.

## **2.2 SOLVENT WELD COMPOUND**

- .1 Solvent cement for PVC duct joints.

## **2.3 CABLE PULLING EQUIPMENT**

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

## **2.4 MARKERS**

- .1 Warning Tape: non-biodegradable polyethylene film, 76 mm wide, yellow with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW."

# **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 pipe in accordance with manufacturer's instructions and at elevations as indicated.
- .2 Clean inside of ducts before laying.
- .3 Install plastic duct spacers and ensure full, even support every 1.5 m and smooth transition throughout duct length.
- .4 Slope ducts with 1 to 400 minimum slope.
- .5 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.
- .6 Pull through each duct steel mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material.
  - .1 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 Install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Place continuous strip of warning tape 300 mm above duct before backfilling trenches.
- .9 Notify the Consultant for field review upon completion of direct buried ducts and obtain acceptance prior to backfill.

## **3.3 CLEANING**

- .1 Clean in accordance with Section 01 11 00 – General Requirements.

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 11 00 – General Requirements.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation procedures for the underground electrical service.

**1.2 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.
- .3 Section 26 05 21 – Wires and Cables (0-1000V).
- .4 Section 26 05 28 – Grounding - Secondary.
- .5 Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.
- .6 Section 33 65 76 – Direct Buried Underground Cable Ducts.

**1.3 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI).

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 11 00 – General Requirements: Submittal Procedures.

**1.5 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Perform Work to comply with the applicable Provincial/Territorial regulations.
  - .2 Coordinate and meet the requirements of the power supply authority.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Underground ducts: rigid type DB2, size as indicated, in accordance with Section 33 65 76 – Direct Buried Underground Cable Ducts.
- .2 Conductors: copper type RWU90, size and number of conductors as indicated, in accordance with Section 26 05 21 – Wires and Cables (0-1000V).
- .3 Backfill: clean and free of debris.
- .4 Rigid PVC 90 degrees, 45 degrees bends and 5 degrees angle couplings as required.
- .5 Expansion joints every 30 m and as required.

**2.2 PULL BOXES**

- .1 Pull Boxes are to be minimum 457mm deep, fiberglass construction, ANSI tier 8 load rating. Standard of acceptance:
  - .1 Hubbell: FRP Box B1324218B.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install cables in trenches and in ducts in accordance with Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.
- .2 Allow adequate conductor length for connection to service equipment.
- .3 Make grounding connections in accordance with Section 26 05 28 – Grounding - Secondary.
- .4 Seal ducts and conduits at building entrance location after installation of cable.

**3.2 CLEANING**

- .1 Clean in accordance with Section 01 11 00 – General Requirements.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 11 00 – General Requirements.

**END OF SECTION**