

**PART 1      GENERAL**

**1.1            GENERAL**

- .1      Include in electrical section, provision of labour, new materials, tools, transportation, services and facilities for a complete electrical installation. The installation shall be left complete in all respects and ready for operation to the complete satisfaction of the responsible Electrical Consultant.
- .2      The electrical scope of work includes, but is not necessarily limited to the following provisions:
  - .1      Provision of power and communications raceways for RFID Infrastructure upgrade.
  - .2      Provision of branch circuitry as indicated on the drawings and as per code.
  - .3      Provision of power connections to owners equipment.
  - .4      Provide electrical demolition as required to completely remove all existing electrical systems, equipment and associated wiring and raceways interfering with the RFID upgrade at the project area.

**END OF SECTION**

**PART 1      GENERAL**

**1.1            CODES AND STANDARDS**

- .1      Do complete installation in accordance with CSA C22.1-2012 as amended by the Provincial/Territorial Building Code, except where specified otherwise.
- .2      Comply with CSA Electrical Bulletins in force at time of tender submission, while not identified and specified by number in this Division, are to be considered as forming part of related CSA Part II standard.
- .3      Do overhead and underground systems in accordance with CSA C22.3 No. 1-10 except where specified otherwise.
- .4      Do complete installation in accordance with latest Electrical Bulletins of the local inspection authority.
- .5      Abbreviations for electrical terms: to CSA Z85-1963.

**1.2            PERMITS, FEES**

- .1      Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2      Pay associated fees.
- .3      Architect will provide drawings at no cost.

**1.3            SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

- .1      Submit shop drawings, product data and samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3      Where applicable, include wiring, single line and schematic diagrams.
- .4      Include wiring drawings or diagrams showing interconnection with work of other Sections and Divisions.
- .5      Include shop drawings for all electrical items and equipment including wiring devices, motor starters, distribution equipment, luminaires, etc

**1.4            OPERATION AND MAINTENANCE DATA**

- .1      Provide operation and maintenance data for incorporation into maintenance manual specified in Section 01 78 00 - Closeout Submittals.
- .2      Include in operations and maintenance data:
  - .1      Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance,

repair, modification, extension and expansion of any portion or feature of installation.

- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
- .3 Wiring and schematic diagrams and performance curves.
- .4 Names and addresses of local suppliers for items included in maintenance manuals.

- .3 O & M manuals to be provided in hard copy and electronic ".PDF" format.

### **1.5 MAINTENANCE MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

### **1.6 CARE, OPERATION AND START-UP**

- .1 Instruct operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .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.

### **1.7 VOLTAGE RATINGS**

- .1 Operating voltages: to CSA C235-1969(R1979).
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Where appliances such as stoves are supplied by other sections, advise the General Contractor in writing of the voltage at the outlet.

### **1.8 INSPECTION**

- .1 Furnish a Certificate of Acceptance from Inspection Department on completion of work.

### **1.9 MATERIALS AND EQUIPMENT**

- .1 Shall be new and CSA approved.
- .2 Shall be manufactured in accordance with current CEMA, NEMA, or CSA standards.
- .3 Bidders shall submit a quotation only on the material and equipment specified and as shown on the drawings.

- .4 No lot pricing shall be allowed. Distributors submitting prices to Electrical Contractors shall not group products and materials.
- .5 Requests for approval of material and equipment, other than those specified on the drawings, shall be submitted not later than seven working days before the close of tender. Requests for approval shall be submitted with complete details of the construction and performance of the materials and equipment. Requests submitted without sufficient supporting information shall be rejected.
- .6 Materials and equipment of the same classification, type of function, shall be provided by the same manufacturer.

**1.10 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 25 and shown on mechanical drawings.

**1.11 FINISHES**

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.
  - .2 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, prime and paint exposed hangers, racks, fastenings to prevent rusting.

**1.12 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
- .2 Nameplates:
  - .1 Lamacoid 5mm thick plastic engraving sheet, black face, white core, mechanically attached unless specified otherwise.

**NAMEPLATE SIZES**

Size 1	13 x 38 mm	1 line 3mm high letters
Size 2	13 x 51 mm	1 line 5mm high letters
Size 3	13 x 51 mm	2 lines 3mm high letters

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Size 4	19 x 76 mm	1 line 8mm high letters
Size 5	19 x 76 mm	2 lines 3mm high letters
Size 6	25 x 102 mm	1 line 13mm high letters
Size 7	25 x 102 mm	2 lines 6mm high letters

- .3 Wording on nameplates to be approved by Department Representative prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Identify all electrical equipment such as motor starters, panelboards, distributions, distribution circuit breakers with nameplates.

**1.13 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1-2012.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 Identify all underground wiring with Brady Identoline underground warning tape or equivalent. Installation to be as per manufacturers typical installation procedure.

**1.14 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours to be 1 inch wide prime colour and 19mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	yellow	
up to 600 V	yellow	green
up to 5 kV	yellow	blue
up to 15 kV	yellow	red
Telephone	green	
Lighting	green	blue
Fire alarm	red	
Emergency voice	red	blue
Other systems	red	yellow

**1.15 WIRING TERMINATIONS**

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

**1.16 MANUFACTURERS AND CSA LABELS**

- .1 Manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

**1.17 WARNING SIGNS**

- .1 Provide warning signs, as specified or to meet requirements of Inspection Department and Electrical Consultant.

**1.18 LOCATION OF OUTLETS**

- .1 Make all necessary adjustments after interior finishes are completed.
- .2 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3m, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms on latch side of door. Confirm direction of door swing on Architectural drawings prior to installation.

**1.19 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 indicated verify before proceeding with installation.
- .3 Confirm luminaire locations with Architect prior to rough-in.
- .4 Install electrical equipment at the following heights unless indicated otherwise.
  - .1 Local switches: 1200mm.
  - .2 Wall receptacles:
    - .1 General: 300mm.
    - .2 Above top of continuous baseboard heater: 200mm.
    - .3 Above top of counters or splash back: 200mm.
    - .4 In mechanical rooms: 1400mm
  - .3 Panelboards: 1200mm or as required by Code.
  - .4 Telephone outlets: 300mm
  - .5 Wall mounted telephone outlets: 1400mm

- .6 Fire alarm stations: 1200mm
- .7 Fire alarm audible devices: 2000mm
- .8 Television outlets: 300mm (unless wall mounted - refer to architectural)
- .9 Wall mounted speakers: 2000mm
- .10 Clocks: 200mm
- .11 Door bell pushbuttons: 1400mm
- .12 P. A. Station: 1400mm
- .13 In accordance with accessibility guidelines

**1.20 PROTECTION**

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

**1.21 LOAD BALANCE**

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, a report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

**1.22 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete: metal, sized for free passage of conduit, and protruding 52mm.
- .2 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 All penetrations through exterior walls are to be made water and weatherproof.

**1.23 FIREPROOFING**

- .1 Where cables or conduits pass through floors and fire rated walls, complete integrity of wall type to the satisfaction of the Electrical Consultant and local inspection authority.
- .2 All emergency feeders and control wires to be 2 hour rated via use of mineral insulated cables or equivalent fireguard application by electrical section.

**1.24 TESTS**

- .1 Conduct and pay for tests of the following:
  - .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, emergency shut-off.
  - .6 Emergency power system including, emergency lighting, UPS.
- .2 Furnish manufacturer's, certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturers instructions. Include in project document manual.
- .3 Carry out tests in presence of Electrical Consultant.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results.

**1.25 INSULATION RESISTANCE TESTING**

- .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
- .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing.
- .4 Include results in project document manual.

**1.26 CO-ORDINATION OF PROTECTECT DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays, fuses, are installed to values and settings as indicated.

**1.27 CLEANING**

- .1 Clean all outlets, cabinets, enclosures, tubs and similar electrical equipment of all construction dust and dirt.
- .2 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 Clean all coverplates and insure all paint is removed from wiring devices, panels, luminaires and other electrical equipment.

**1.28 EXCAVATION AND BACKFILLING**

- .1 Ensure that excavation for underground electrical services is in location and at depth indicated. Electrical contractor to directly supervise excavation and backfilling.

- .2 All work to be accordance with CSA22.1-2012 Section 12.

**1.29 GUARANTEE**

- .1 The Electrical Contractor shall guarantee the satisfactory operation of all work and apparatus included and installed under this section of the specification.
- .2 Replace forthwith at no additional material, or labour cost any part which may fail or prove defective within a period of twelve (12) calendar months after the final acceptance of the complete building, provided that such failure is not due to improper usage, or ordinary wear and tear.
- .3 No certificate given payment made, partial or entire use of the equipment by the Owner, shall be construed as acceptance of defective work.
- .4 This general guarantee shall not act as a waiver of any specified guarantee for any greater length of time.

**1.30 CUTTING AND PATCHING**

- .1 Pay all costs for cutting and patching required for the installation of electrical work.
- .2 Assume full responsibility for laying out electrical work and for any damage caused by incorrectly located equipment or improper performance of this work.
- .3 Study the architectural plans and co-operate with other trades so that the elevation of all outlets shall not necessitate any unnecessary cutting of dados, mirrors, tiles or other construction material. If this is not done, the Electrical Contractor may be required by the Electrical Consultant to move these outlets at no additional cost to the Owner (including repair).

**1.31 CO-OPERATION**

- .1 Schedule execution of work with associated work specified in other Divisions. Check shop drawings of other sections prior to electrical rough-in to co-ordinate physical and electrical requirements. Adjust as required.

**1.32 SPARE MATERIALS**

- .1 Provide the following spare parts:
- .1 Spare parts as noted in individual sections

**1.33 DRAWINGS**

- .1 Carefully examine all drawings and specifications relating to the work to be certain that the work under this contract can be satisfactorily carried out and prior to submission of tender, examine the work of the other trades and report at once to the Electrical Consultant, any defect, discrepancy, omission or interference affecting the work of section or the warranty of same.
- .2 The drawings accompanying these specifications are intended to show the general arrangement and extent of the work to be done, but the exact location and arrangement of all parts shall be determined as the work progresses. The location of the outlets,

equipment, etc. as given on the drawings are approximately correct but it shall be understood that they are subject to such modifications as may be found necessary or desirable at the time of installation to meet any structural, mechanical or architectural conditions. Such changes shall be made by the Electrical Contractor, as directed by the Electrical Consultant without additional charge.

- .3 At completion of project, provide a complete print of revisions, changes and conduit location as-built drawings to the satisfaction of the responsible Electrical Consultant. Provide electronic AutoCAD ".dwg" format files of all changes, revisions, and conduit layouts suitable for printing drawing size reproductions of electrical drawings. Electrical Consultant will provide electronic copies of original electrical drawings.

**END OF SECTION**

**PART 1      GENERAL**

**1.1            SECTION INCLUDES**

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

**1.2            RELATED SECTIONS**

- .1      Section 26 05 00 – Electrical Scope

**1.3            REFERENCES**

- .1      Canadian Standards Association (CSA)
  - .1      CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.
  - .2      CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2      Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1      EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3      National Electrical Manufacturers Association (NEMA)

**PART 2      PRODUCTS**

**2.1            MATERIALS**

- .1      Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2      Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3      Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1      Connector body and stud clamp for stranded copper conductors.
  - .2      Clamp for copper bar.
  - .3      Stud clamp bolts.
  - .4      Bolts for copper bar.
  - .5      Sized for conductors and bars as indicated.
- .4      Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

**PART 3      EXECUTION**

**3.1            INSTALLATION**

- .1      Remove insulation carefully from ends of conductors and:
  - .1      Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
  - .2      Install fixture type connectors and tighten. Replace insulating cap.
  - .3      Install bushing stud connectors in accordance with EEMAC 1Y-2.

**END OF SECTION**

**PART 1      GENERAL**

**1.1            RELATED SECTIONS**

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

**1.2            REFERENCES**

- .1      Canadian Standards Association (CSA)
  - .1      CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
  - .2      CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

**PART 2      PRODUCTS**

**2.1            BUILDING WIRES**

- .1      Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2      Copper and ACM alloy conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE as indicated. Provide RWU90 XLPE rated cable for underground wiring. Related to new service entrance feeders and site lighting circuits. RWU90 XLPE not required under interior floor slabs.
- .3      Copper conductors: size as indicated, with thermoplastic insulation type TWH rated at 600 V, typically used for insulated ground wires.
- .4      Type ACM conductors permitted for feeders above 60 amps.

**2.2            TECK Cable**

- .1      Cable: to CAN/CSA-C22.2 No. 131.
- .2      Conductors:
  - .1      Grounding conductor: copper.
  - .2      Circuit conductors: copper and ACM alloy, size as indicated.
- .3      Insulation:
  - .1      Cross-linked polyethylene XLPE, rating – 600 V.
- .4      Inner jacket: polyvinyl chloride material.
- .5      Armour: interlocking aluminum, compliant to applicable Building Code classification for this project.

- .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 dia. to support suspended channels.
- .8 Connectors:
  - .1 Watertight and/or type approved for TECK cable, as indicated.

### **2.3 MINERAL-INSULATED CABLES**

- .1 Conductors: solid bare soft-annealed copper, size as indicated.
- .2 Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.
- .3 Overall covering: annealed seamless copper sheath, Type M1 rated 600 V, 250°C.
- .4 Overall jacket: PVC applied over the sheath and compliant to applicable Building Code classification for this project for direct buried and wet locations, as indicated.
- .5 Two hour fire rating.
- .6 Connectors: watertight, field installed, approved for MI cable.
- .7 Termination kits: field installed approved for MI cable.

### **2.4 ARMOURED CABLES**

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

### **2.5 CONTROL CABLES**

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

**2.6 NON-METALLIC SHEATHED CABLE**

- .1 Non-metallic sheathed copper cable type: NMD90 nylon, size as indicated.

**2.7 ACM Conductors**

- .1 Annealed, compacted aluminum alloy conductor material (ACM) for circuits 60 amps or more, single or multi-conductor, 600 volt insulation.
- .2 Type: AC90, ACWU90 and TECK90.
- .3 Armour: interlocked aluminum strip.
- .4 Conductivity: 61% IACS to that of copper.
- .5 Outer jacket: ACWU90 PVC jacket, FT-4 rated suitable for direct buried and Div. 1 and Div. 2 hazardous locations.

**PART 3 EXECUTION**

**3.1 FIELD QUALITY CONTROL**

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

**3.2 GENERAL CABLE INSTALLATION**

- .1 Install cable in trenches in accordance with Section 33 71 73.02 - Underground Electrical Service.
- .2 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .4 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.
- .5 Conductor length for parallel feeders to be identical.
- .6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

- .7 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.
- .8 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.
- .9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### **3.3 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34- Conduits, Fastenings and Fittings.
  - .2 In cable troughs in accordance with Section 26 05 33.01- Cable Trays for Electrical Systems.
  - .3 In underground ducts in accordance with Section 26 05 43.01- Installation of Cables in Ducts.
  - .4 In trenches in accordance with Section 26 05 43.01- Installation of Cables in Trenches.
  - .5 In underfloor distribution system in accordance with Section 26 05 39- Underfloor Raceways for Electrical Systems
  - .6 In cellular floor raceways in accordance with Section 26 05 38 – Cellular Metal Floor Raceway Fittings.
  - .7 In surface and lighting fixture raceways in accordance with Section 26 50 00- Lighting.
  - .8 In wireways and auxiliary gutters in accordance with Section 26 05 37 – Wireways and Auxiliary Gutters.
  - .9 Overhead service conductors in accordance with Section 26 24 01 - Service Equipment.

### **3.4 INSTALLATION OF TECK CABLE 0 -1000 V**

- .1 Install cables.
  - .1 Group cables wherever possible on channels.
- .2 Install cable concealed, securely supported by straps and hangers.

### **3.5 INSTALLATION OF MINERAL-INSULATED CABLES**

- .1 Run cable exposed, securely supported by straps.
- .2 Support 2 h fire rated cables at 1m intervals.
- .3 Make cable terminations by using factory-made kits.

- .4 At cable terminations use thermoplastic sleeving over bare conductors.
- .5 Where cables are buried in cast concrete or masonry, sleeve for entry and exit of cables.
- .6 Do not splice cables.

**3.6 INSTALLATION OF ARMOURED CABLES (AC-90)**

- .1 Group cables wherever possible.
- .2 Use permitted only for work in movable partitions and vertical power supply drops to lighting fixtures.

**3.7 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit as indicated.
- .2 Ground control cable shield.

**3.8 INSTALLATION OF NON-METALLIC SHEATHED CABLE**

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.
- .3 Use permitted in wood stud construction only.

**3.9 INSTALLATION OF ACM CONDUCTORS**

- .1 Install ACM cables as per the latest edition of the Canadian Electrical Code and manufacturers installation requirements.
- .2 Do not terminate ACM conductors with a copper bodied connector.
- .3 Apply oxide coating on base cables as per electrical code requirements.

**END OF SECTION**

**PART 1      GENERAL**

**PART 2      PRODUCTS**

**2.1            MATERIALS**

- .1      Grounding equipment to: CSA C22.2No.41 1950(R1967).
- .2      Copper grounding conductors to: ASA G7.1- 1964.

**2.2            EQUIPMENT**

- .1      Clamps for grounding of conductor, size as required to electrically conductive underground water pipe or ground rods as required by inspection authority.
- .2      System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, size as required.
- .3      Insulated grounding conductors to Section. 26 05 21.
- .1      Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .4      Non-corroding accessories necessary for grounding systems, type, size, material as required, including but not necessarily limited to:
  - .1      Grounding and bonding bushings.
  - .2      Thermit welded type conductor connectors.
  - .3      Bolted type conductor connectors.
  - .4      Bonding jumpers, straps.

**2.3            MANUFACTURERS**

- .1      Acceptable manufacturers: Burndy, Cadweld or equivalent.

**PART 3      EXECUTION**

**3.1            INSTALLATION GENERAL**

- .1      Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of Electrical Consultant and local authority having jurisdiction over installation. Where EMT is used, run ground wire in conduit.
- .2      Install connectors to manufacturers instructions.

- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor, to outdoor lighting standards.
- .9 Ground secondary service pedestals.
- .10 Route all ground conductors back to existing main building ground.

### **3.2 ELECTRODES**

- .1 Install rods as required by local inspection authority. Provide all grounding as per local inspection authority requirements.

### **1.2 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, window frames, sensor support frames, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, distribution panels, outdoor lighting.

### **1.3 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports on wall of HOGEN room and inflation room.
- .2 Ground items of electrical equipment, metal frames, sensor supports etc. in HOGEN room and inflation room to ground bus with individual bare stranded copper connections size 2/0AWG.

### **3.3 TESTS**

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Electrical 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**

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**PART 1 GENERAL**

**1.1 RELATED WORK**

- .1 General Provisions: Section 26 05 01

**PART 2 PRODUCTS**

**2.1 SUPPORT CHANNELS**

- .1 U shape, size 38mm x 38mm, 25mm thick, surface mounted, suspended, set in poured concrete walls and ceilings as required.

**2.2 MANUFACTURERS**

- .1 Acceptable manufacturers: Burndy, Electrovert, Unistrut

**2.3 FASTENINGS**

- .1 Lead anchors or nylon shields to secure equipment and conduit straps.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Secure fastenings and supports as required for each type of equipment, cables and conduits and to manufacturers installation recommendations.

**END OF SECTION**

**PART 1      GENERAL**

**1.1            SHOP DRAWINGS AND PRODUCT DATA**

- .1      Submit shop drawings and product data for cabinets in accordance with Section 26 05 01.

**PART 2      PRODUCTS**

**2.1            JUNCTION AND PULL BOXES**

- .1      Welded steel construction with screw-on flat covers for surface mounting.
- .2      Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3      Provide cast junction boxes for all exterior/weatherproof installations.
- .4      Explosion proof type boxes in hazardous locations matching Class and Division identified.

**PART 3      EXECUTION**

**3.1            JUNCTION, AND PULL BOXES INSTALLATION**

- .1      Install pull boxes in inconspicuous but accessible locations.
- .2      Mount cabinets with top not higher than 1830mm above finished floor.
- .3      Provide pull boxes so as not to exceed 30m of conduit run between pull boxes.

**3.2            IDENTIFICATION**

- .1      Install size 2 identification labels indicating system name voltage and phase in accordance with Section 26 05 01.

**END OF SECTION**

**PART 1      GENERAL**

**1.1            RELATED WORK**

- .1      Box connectors: Section 26 05 20.

**PART 2      PRODUCTS**

**2.1            OUTLET AND CONDUIT BOXES GENERAL**

- .1      Size boxes in accordance with CSA C22.1-2012, Section 12.
- .2      100mm square or larger outlet boxes as required for special devices.
- .3      Gang boxes where wiring devices are grouped.
- .4      Blank cover plates for boxes without wiring devices.

**2.2            SHEET STEEL OUTLET BOXES**

- .1      Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 75mm x 50mm x 38mm or as required. 100mm square outlet boxes when more than one conduit enters one, side with extension and plaster rings as required.
- .2      Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 100mm x 50mm x 50mm.
- .3      100mm square or octagonal outlet boxes for lighting fixture outlets.
- .4      100mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

**2.3            CONDUIT BOXES**

- .1      Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle in exterior or wet or Class 1 areas.

**2.4            FITTINGS GENERAL**

- .1      Bushing and connectors with nylon insulated throats.
- .2      Knock-out fillers to prevent entry of foreign materials.
- .3      Conduit outlet bodies for conduit up to 32mm and pull boxes for larger conduits.

- .4 Double locknuts and insulated bushings on sheet metal boxes.

## **2.5 OUTLET BOXES – EXPLOSION PROOF TYPE**

- .1 In hazardous locations all boxes shall match Class and Division identified.

## **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 construction material.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not allowed.
- .5 Use of boxes with built-in connectors is not permitted.
- .6 Use of sectional boxes is not permitted.

**END OF SECTION**

**PART 1      GENERAL**

**1.1            LOCATION OF CONDUIT**

- .1      Drawings do not show all conduits. Those shown are in diagrammatic form only.

**PART 2      PRODUCTS**

**2.1            CONDUITS**

- .1      Rigid galvanized steel threaded conduit: size as indicated or required; to CSA C22.2 No.45
- .2      Electrical metallic tubing (EMT), with couplings to CSA22.2 No.83
- .3      Rigid pvc conduit: size as indicated; to CSAC22.2 No.136
- .4      Flexible metal conduit and liquid-tight flexible metal conduit: size as indicated; to CSAC22.2 No. 56.
- .5      Minimum conduit size to be 19mm.

**2.2            CONDUIT FASTENINGS**

- .1      One hole steel straps to secure surface conduits 50mm and smaller. Two hole steel straps for conduits larger than 50mm.
- .2      Beam clamps to secure conduits to exposed steel work.
- .3      Channel type supports for multiple conduits.
- .4      6mm dia. threaded rods to support suspended channels.

**2.3            CONDUIT FITTINGS**

- .1      Fittings manufactured for use with conduit specified.
- .2      Factory "ells" where 90° bends are required for 25mm and larger conduits.

**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      Surface mount conduits.
- .3      Use rigid galvanized steel threaded conduit in Class 1 Division 1 and 2 areas and where otherwise noted.
- .4      Use electrical metallic tubing (EMT) unless otherwise noted.
- .5      Use rigid pvc conduit underground, unless otherwise prohibited or noted.
- .6      Use flexible metal conduit or AC90 for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures, work in movable metal partitions.
- .7      Use liquidtight flexible metal conduit for connection to motors in damp or wet locations.
- .8      Use explosion proof flexible connection for connection to explosion proof motors.
- .9      Install conduit sealing fittings in hazardous areas. Fill with compound.
- .10     Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11     Mechanically bend steel conduit over 19mm dia.
- .12     Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13     Install polypropylene fish cord in empty conduits.
- .14     Run 2-25mm spare conduits up to ceiling space and 2-25mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 150mm x 150mm x 100mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in a flush concrete surface type box.
- .15     Where conduits become blocked, remove and replace blocked section.
- .16     Dry conduits out before installing wire.

**3.2            SURFACE CONDUITS**

- .1      Run parallel or perpendicular to building lines.

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- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on suspended surface channels.
- .4 Do not pass conduits through structural members except as indicated.

**3.3 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc accepted) with a heavy coat of bituminous paint.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 01.
- .2 Provide short circuit fault study with shop drawings. Study shall bear the seal of Engineer.

**PART 2 PRODUCTS**

**2.1 BREAKERS GENERAL**

- .1 Bolt-on moulded case circuit breaker, quick- make, quick-break type, for manual and automatic operation.
- .2 Common-trip breakers with single handle for multipole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting.
- .4 Instantaneous interrupting capacity to be co-ordinated with available fault current.
- .5 Moulded case circuit breakers: to CSA C22. No. 5 -1963.
- .6 Circuit breakers to be series rated.

**2.2 THERMAL MAGNETIC BREAKERS**

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

**2.3 MANUFACTURERS**

- .1 Acceptable manufacturers: to match Section 26 24 17 - Service Entrance Board.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

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- .2 Coordinate short circuit interrupting capacity with the utility. Provide written report and submit to engineer and power authorities.

**END OF SECTION**