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**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1    CSA Group
  - .1    CSA C22.1-18, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2    CAN3-C235-83 (R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2    Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1    IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

**1.2                DEFINITIONS**

- .1    Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Product Data:
  - .1    Submit manufacturer s instructions, printed product literature and data sheets for
- .2    Shop drawings:
  - .1    Submit drawings stamped and signed by professional engineer registered or licensed in Newfoundland and Labrador, Canada.
- .3    Certificates:
  - .1    Provide CSA certified equipment and material.
- .4    Where it is proposed to make a change or changes in the design, agreement or type of equipment called for in this specification, the electrical contractor shall estimate the cost of same and submit in triplicate detailed itemized estimates of the costs of all apparatus, materials and labour entering into the change or substitution.

**1.4                CLOSEOUT SUBMITTALS**

- .1    Operation and Maintenance Data:
  - .1    Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
  - .2    Operating instructions to include following:
    - .1    Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2    Safety precautions.
    - .3    Procedures to be followed in event of equipment failure.

- .4 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

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

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer s name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors, in dry location, off ground, and in accordance with manufacturer s recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification labels for control items in English.
- .4 All equipment and exposed non-current carrying metal, conduits and parts to be permanently and effectively grounded to meet minimum requirements of the CEC section 10 and as indicated on drawings and further specified. Standards set either by drawings or specifications which are above those covered by the C.E.C. section 10 are not to be reduced under any circumstances.

### **2.2 MATERIALS AND EQUIPMENT**

- .1 Provide material equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Equipment and Material to be CSA certified. Where CSA certified equipment material is are not available, obtain special approval from authority having jurisdiction before delivery to site.

- .3 Factory assemble control panels and component assemblies.
- .4 Where it is proposed to make a change or changes in the design, agreement or type of equipment called for in this specification, the electrical contractor shall estimate the cost of same and submit in triplicate detailed itemized estimates of the costs of all apparatus, materials and labour entering into the change or substitution.

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

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

## **2.4 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of inspection authorities and manufacturer's recommendation

## **2.5 WIRING TERMINATIONS**

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

## **2.6 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates or labels.
- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

## **2.7 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, 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 coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

## **2.8 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

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## **2.9 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Where contractor is unsure of work to be performed, they shall request direction from Departmental Representative prior to proceeding with work.

### **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 pouring of concrete.
  - .1 Sleeves through concrete: sheet metal, sized for free passage of conduit, and protruding 50 mm.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

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

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

### **3.5 FIELD QUALITY CONTROL**

- .1 Conduct following tests in accordance with Section 01 45 00 – Quality Control:
  - .1 Voltage drop on circuits originating from branch distribution panels.
  - .2 Motors associated control equipment including sequenced operation of systems where applicable.
  - .3 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
    - .2 Check resistance to ground before energizing.
- .2 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

**3.6 SYSTEM STARTUP**

- .1 Instruct Departmental Representative in operation, care and maintenance of systems, system equipment and components.

**3.7 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
  - .3 Waste Management: separate waste materials for recycling and reuse.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

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**Part 1            General**

**1.1                DELIVERY, STORAGE AND HANDLING**

- .1            Packaging Waste Management: remove for reuse and recycling.

**Part 2            Products**

**2.1                BUILDING WIRES**

- .1            Conductors: stranded for 12 AWG and larger. Minimum size: 12 AWG.
- .2            Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.
- .3            All wiring for project to be copper.

**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 before energizing electrical system.

**3.2                GENERAL CABLE INSTALLATION**

- .1            Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .2            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.
- .3            Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

**3.3                INSTALLATION OF BUILDING WIRES**

- .1            Install wiring as follows:
  - .1            In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**3.4                INSTALLATION OF CONTROL CABLES**

- .1            Install control cables underground conduit as shown on drawings.

.2 Ground control cable shield.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling.

**Part 2 Products**

**2.1 JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

**Part 3 Execution**

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

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

**3.2 IDENTIFICATION**

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.

**1.2 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal: Separate waste materials for recycling and reuse.

**Part 2 Products**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.

**2.2 CONDUIT BOXES**

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

**2.3 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 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 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .4 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .5 Identify systems for outlet boxes as required.

**END OF SECTION**

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**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No. 45-M1981 (R2008), Rigid Metal Conduit.
  - .2 CSA C22.2 No. 211.2-M1984 (R2003), Rigid PVC (Unplasticized) Conduit.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

**Part 2 Products**

**2.1 CABLES AND REELS**

- .1 Provide cables on reels or coils.
  - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.

**2.2 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Rigid PVC conduit: to CSA C22.2 No. 211.2.

**2.3 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
  - .1 Two-hole steel straps for conduits larger than 50 mm.

**2.4 CONDUIT FITTINGS**

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.  
Coating: same as conduit.

**2.5 FISH CORD**

- .1 Polypropylene.

**Part 3 Execution**

**3.1 MANUFACTURER S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Use rigid galvanized steel threaded conduit except where specified otherwise.
- .2 Use rigid PVC conduit underground.
- .3 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .4 Mechanically bend steel conduit over 19 mm diameter.
- .5 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .6 Install fish cord in empty conduits.
- .7 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .8 Dry conduits out before installing wire.

**3.3 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Locate to suit reinforcing steel.
  - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Organize conduits in slab to minimize cross-overs.

**3.4 CONDUITS UNDERGROUND**

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

**3.5 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1                DELIVERY, STORAGE AND HANDLING**

- .1    Deliver, store and handle materials in accordance with manufacturer s written instructions.
- .2    Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer s name and address.
- .3    Storage and Handling Requirements:
  - .1        Store materials indoors, off ground, in dry location, and in accordance with manufacturer s recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect cables from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.
- .4    Packaging Waste Management: remove for reuse by manufacturer and return of padding, packaging materials crates, pallets, as specified in Construction Waste Management Plan.

**Part 2            Products**

**2.1                CABLE PROTECTION**

- .1    As shown on drawings.

**Part 3            Execution**

**3.1                EXAMINATION**

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

**3.2                CABLE INSTALLATION IN DUCTS**

- .1    Install cables as indicated in ducts.
- .2    Do not pull spliced cables inside ducts.
- .3    Install multiple cables in duct simultaneously.
- .4    Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

### **3.3 MARKERS**

- .1 Where markers are removed to permit installation of additional cables, reinstall existing markers.

### **3.4 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
  - .1 Include necessary instruments and equipment.
- .3 Check each feeder for continuity, short circuits and grounds.
  - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .4 Remove and replace entire length of cable if cable fails to meet any of test criteria.

### **3.5 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.6 PROTECTION**

- .1 Repair damage to adjacent materials caused by cables installation.

**END OF SECTION**