

**Part 1            General**

**1.1                REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2.
  - .3 CAN/CSA-C22.3 No. 1, Overhead Systems.
  - .4 CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 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                ELECTRICAL SUBCONTRACTOR REQUIREMENTS**

- .1 Comply with all Department of Labour, Workplace and Health requirements at all times.
  - .2 All Subcontractors shall have a valid license to operate in the City of Winnipeg.
  - .3 The complete installation shall be carried out in neat and workmanlike manner to the satisfaction of the Contract Administrator.
  - .4 All Electrical Subcontractor employees on Site shall have valid Trade Licenses.
  - .5 Electrical Subcontractor shall maintain the appropriate ratio of Journeymen Electricians & Apprentices required by Provincial Codes. Only qualified workmen shall be employed on this contract. Supervision shall be by Journeymen Electricians and Work carried out by Journeymen and/or registered apprentices only.
  - .6 Obtain all necessary permits & pay all fees and arrange for inspection with City of Winnipeg.
  - .7 Obtain a certificate of final inspection and approval from inspection department having jurisdiction on completion of Work.
  - .8 All materials, tools, appliances, scaffolding, apparatus, and labour necessary for the execution, erection and completion of specified systems shall be furnished.
  - .9 Provide all labour and materials necessary for complete and operating systems as indicated on the drawings and specified herein. Any Work and material, even if not shown or specified, which is obviously necessary or reasonably implied to complete the Work shall be provided as if it was both shown, and specified.
  - .10 Unless otherwise specifically noted, any issues which are not part of electrical / telecommunication area of expertise, even if mentioned in these documents, are indicated only for reference and coordination purposes only (with other trades).
-

- .11 The Electrical Subcontractor shall consult with all other sub-trades involved to confirm the locations of the various outlets and equipment and shall cooperate fully to ensure that no conflict arises during the installation. In case of any difference of opinion, the matter shall be referred to the Contract Administrator for final decision.
- .12 Electrical Subcontractor is responsible for arranging and coordinating with other divisions for proper drainage of electrical conducts entering from outside, drainage of all exterior electrical junction and pull boxes, sealing and waterproofing of all electrical penetrations; methods of firestopping, and envelope penetration.

### **1.3 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.

### **1.4 DESIGN REQUIREMENTS**

- .1 All electrical design drawings, details and specifications are diagrammatic, and unless specifically noted by figured dimensions, indicate the general arrangement of receptacles, light fixtures, switches, risers, panels, etc. Any information involving accurate dimensions, shall be obtained from detailed dimensioned drawings or by actual measurements at the building. If doubt exists as to the final location, the Electrical Subcontractor shall contact the Contract Administrator for clarification prior to installation. The location of switches, receptacles, outlets, etc., shall be coordinated with built-in units, appliances and equipment, mechanical equipment, etc., as shown on the architectural and mechanical drawings and/or as existing.
- .2 Where space is indicated for future equipment, leave such space clear and install feeders and equipment pertaining to this contract in such a way that future equipment can be easily installed.
- .3 Electrical Subcontractor shall coordinate locations of lighting fixtures with sprinklers, mechanical ducts, diffusers, beams, and other architectural, structural, and mechanical items. Any relocation required shall be performed at no cost to the City
- .4 Operating voltages: to CAN3-C235.
- .5 Language operating requirements: provide identification nameplates and labels for control items in English.

### **1.5 PLANS**

- .1 The Electrical Subcontractor shall familiarize them self with the plans which show the approximate locations of outlets and apparatus. The right is reserved to make such changes in location as may be necessary to meet contingencies of construction. No extras will be allowed for such changes to any piece of electrical equipment, outlets, etc., unless the distance exceeds 3000mm.
  - .2 Should a discrepancy appear between plans, specifications, or the actual conditions encountered on the Site, which leaves the Electrical Subcontractor in doubt as to the true intention and meaning of the plans and specifications, a ruling shall be obtained in writing from the Contract Administrator which will be final.
-

## 1.6 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Shop drawings:
    - .1 Prior to manufacturing any item required for this job, the Electrical Subcontractor shall submit detailed shop drawings of the item. Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
    - .2 Shop drawings must be received by the Contract Administrator at a date early enough to permit reasonable study prior to review and manufacturer, or to permit alterations where necessary. Facsimile transmission of shop drawings will **NOT BE ACCEPTED**. Late submissions of shop drawings will be sufficient reason for stoppage of construction pending review, or removal and replacement of any unsatisfactory item at the Electrical Subcontractor's expense.
    - .3 Electrical Subcontractor shall allow a minimum of ten (10) business days for shop drawing review by the Contract Administrator and time shall be incorporated in construction schedule, so no delays occur due to late submission of shop drawings.
    - .4 Shop drawings shall be submitted by email, bearing Electrical Subcontractors' signatures. All shop drawings shall be stamped by the Electrical Subcontractor prior to submission. Prints will be returned with review stamp and/or appropriate comments.
    - .5 Shop drawings shall be reviewed by the Contract Administrator. Corrections or comments made on the shop drawings during this review do not relieve Electrical Subcontractor from compliance with requirements of the drawings and specifications. This review is only for the general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Electrical Subcontractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her Work with that of all other trades and performing all Work in a safe and satisfactory manner.
    - .6 Shop drawings shall be provided for all system components.
  - .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
    - .1 Any electrical material and/or equipment supplied by Contractor or Subcontractors for installation on this project must bear evidence of certification by authorized organization (e.g. CSA) or special certification acceptable to the Chief Inspector of Electrical Energy for the Province of Manitoba.
    - .2 Any material and/or equipment not complying with this requirement and found on the job Site will be subject to rejection and replacement with approved equipment at no additional cost
    - .3 Electrical Subcontractor, upon receipt of equipment purchased by the City for installation on this project, shall examine it for compliance with the above requirements. Report any non approved equipment to the Contract Administrator for action. Such equipment shall be returned to its packing crate until instructions are received from the Contract Administrator.
    - .4 Submit test results of installed electrical and telecommunication systems.
    - .5 Permits and fees: in accordance with General Conditions of contract.
    - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Contract Administrator.
-

- .4 Substitutions:
  - .1 Unless otherwise noted on the plans or specifications, substitutions may be allowed by the Contract Administrator, when requested by the Electrical Subcontractor or by equipment suppliers, for items specified by manufacturer and catalogue number.
  - .2 Requests for review of such substitutions shall be submitted via email at least seven working days prior to the Bid date. Facsimile transmission of substitution drawings and/or specifications will **NOT BE ACCEPTED**.
  - .3 Descriptive catalogue sheets accompanying the approval application which may show several items of varying specifications shall be conspicuously marked in such a manner that the offered substitute item may easily be recognized for comparison.
  - .4 Proposed substitutions must be at least of equal quality to that of the specified item. The manufacturer's specification of the item shall apply for comparison if no other clause of this specification applies. The Contract Administrator will review substitution proposal and will make final decision for the City.
  - .5 Off-the-shelf items which are specified by description only, without any manufacturer, model type or catalogue number, do not require approval prior to the Bid date. However, Electrical Subcontractor shall submit to the Contract Administrator a request for review of such items prior to their use, in sufficient time to permit rejection if unsatisfactory.
  - .6 All additional expenses incurred as a result of substitution will be the direct responsibility of the Electrical Subcontractor.
- .5 O&M Manuals:
  - .1 Submit O&M manuals in a binder complete with warranty certificate, closed out permit, as-builts, and equipment specification sheets.

## 1.7 **QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 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 Acts 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.

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

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 11 - Cleaning.

## 1.9 **SYSTEM STARTUP**

- .1 Instruct Operating Personnel in operation, care and maintenance of systems, system equipment and components.
  - .2 Arrange and pay for services of manufacturer's factory service technician 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.

## **Part 2 Products**

### **2.1 MATERIALS AND EQUIPMENT**

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from authority having jurisdiction before delivery to Site and submit such approval as described in PART 1 - SUBMITTALS.
- .2 Factory assemble control panels and component assemblies.

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

- .1 Verify installation and co-ordination responsibilities related to motors, equipment, and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

### **2.3 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Contract Administrator.
- .2 Decal signs, minimum size 175 x 250 mm.

### **2.4 WIRING TERMINATIONS**

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

### **2.5 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment, including but not limited to electrical Motor Starters, Motor Control Centres, Disconnect Switches, and control panels.
  - .1 Nameplates:
    - .1 Equipment supplied by the non-emergency power system shall be identified using lamacoid 3 mm matt black finish face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.

.2 Sizes as follows:

**NAMEPLATE SIZES**

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.

**2.6 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.

**2.7 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 5 m intervals.

**2.8 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish.
  - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 The Electrical Subcontractor shall obtain and ascertain information from all other sub-trades as to the extent and details of any additional electrical Work to complete all systems served with electrical power or controlled electrically and, where necessary, allow in his Bid for such Work. No extra claim will be accepted for Work on such systems whether they are as specified in architectural, structural, landscape or mechanical plans and specifications; or proposed and accepted as alternate systems.
- .3 Any electrical and communication Work carried out on behalf of, or by, other Subcontractors shall be in accordance with the regulations of the Canadian Electrical Code and the applicable clauses of this specification.
- .4 It shall be the Electrical Subcontractor's responsibility to ensure that all Subcontractors and suppliers of electrical equipment observe the applicable clauses of the electrical specifications.
- .5 In case of differences between Subcontractors regarding extent of Work responsibilities, such matters shall be referred to the Contract Administrator through the Electrical Subcontractor. Should any discrepancy between the specification and drawings leave the Electrical Subcontractor in doubt as to the true intent and meaning, a ruling shall be obtained from the Contract Administrator before the Bid is submitted. If this is not done it will be the Electrical Subcontractor's responsibility to ensure that the more expensive alternate has been included.
- .6 Prior to the Bid, the Electrical Subcontractor shall visit the Site and report to the Contract Administrator any condition which might prevent him from performing his contract as specified. No extra will be allowed for if this procedure is not followed.
- .7 Should any Work or material be needed which is not specified or shown on the drawings and is nevertheless necessary for properly carrying out the obvious intent, such Work or materials shall be provided without additional cost.

**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 CABLE INSTALLATION**

- .1 Install cables close to building structure so furring can be kept to minimum.

**3.4 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. Install electrical equipment at following heights unless indicated otherwise.
-

**3.5 CO-ORDINATION OF PROTECTIVE DEVICES**

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

**3.6 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of Work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers, and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Quality Control.
  - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable.
  - .4 Insulation resistance testing:
    - .1 Megger circuits, feeders, and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders, and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Contract Administrator.
- .4 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.

**3.7 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.

**END OF SECTION**

---

**Part 1      General**

**1.1      RELATED WORK**

- |    |   |                    |
|----|---|--------------------|
| .1 | Mechanical Specifications                 | Division 22 and 23 |
| .2 | Common Work Results                       | Section 26 05 00   |
| .3 | Wires and Cables (0-1000 V)               | Section 26 05 21   |
| .4 | Disconnect Switches - Fused and Non-Fused | Section 26 28 23   |

**1.2      SYSTEM DESCRIPTION**

- .1 Provide complete electrical power and control connections for mechanical equipment.

**Part 2      Products**

**2.1      MATERIALS**

- .1 Include motor starters, lockable disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.
- .2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical equipment, except for temperature/humidity control systems.
- .3 Unless otherwise noted, motors and control devices shall be supplied by Division 22 and 23. Motor horsepower ratings shall be as shown in the Division 22 and 23 specifications. Motor voltage and phase ratings by Division 26.

**2.2      EXTERIOR EQUIPMENT**

- .1 All equipment, mounted on the exterior of the building, shall be weatherproof.

**Part 3      Execution**

**3.1      POWER WIRING**

- .1 Install power feeders, starters, lockable disconnects, and associated equipment and make connections to all mechanical equipment.
- .2 Install branch circuit wiring for mechanical system control panels, time clocks, and control transformers.
- .3 Install main power feeders to starter/control panels furnished by Division 22 and 23. Install branch wiring from starter/control panels to controlled equipment such as motors, electric coils, etc.
- .4 Conduit, wire, devices and fittings required to wire and connect low voltage temperature control systems, shall be supplied and installed by the trade supplying the temperature control system. Control wiring shall be installed in conduit.
- .5 Wire and connect electrical interlocks for starters supplied by Division 22 and 23.
-

**3.2 COORDINATION**

- .1 Refer to mechanical drawings for the exact location of motor control devices, and other mechanical equipment requiring an electrical connection.
- .2 Obtain full information from Division 22 and 23, regarding wiring controls, overload heaters, equipment ratings and over-current protection. Notify the Division 22 and 23, at once, if any information provided is incorrect or unsatisfactory.
- .3 Refer to Division 22 and 23 specifications for any further electrical requirements.
- .4 Review both electrical and mechanical drawings and specifications and coordinate all controls with Mechanical Subcontractors through Electrical Subcontractor. Report all discrepancies to the Contract Administrator before close of Bid. No additional money will be justified for assumptions made on any duplication of information.
- .5 Submit to Electrical Subcontractor, as part of the bid submission, a list of controls and wiring to be provided by the Electrical Subcontractor.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

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

**1.2                REFERENCES**

- .1        Canadian Standards Association (CSA International)
  - .1        CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2        CSA C22.2 No.65-93, Wire Connectors.
- .2        Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1        EEMAC 1Y-2, 1961 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 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        Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.Execution

**2.2                INSTALLATION**

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

**END OF SECTION**

---

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1            Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

**1.2                PRODUCT DATA**

- .1            Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

**1.3                SCOPE OF WORK**

- .1            Provide a complete system of wiring system, making all required connections as indicated on the drawings, specified herein and as required. Unless noted as larger, install and rate all cables and conductors in accordance with the requirements of the current edition of the Canadian Electrical Code.

**Part 2            Products**

**2.1                WIRES**

- .1            Unless otherwise shown or specified, all conductors shall be TECK90, 1000 volt XLPE insulated, and be of minimum size #12 AWG.
- .2            All conductors to be copper only, unless otherwise noted.
- .3            Conductors up to #10 AWG may be solid. Conductors #8 AWG and larger shall be stranded, unless specifically mentioned to be solid.
- .4            Equipment bonding conductors shall be insulated and sized as per the CEC.

**2.2                CONNECTORS AND TERMINALS**

- .1            Use solderless, self-insulated connectors for hand twist wire joints for lighting, small power, heating and associated control devices.
- .2            Connectors #8 AWG gauge and larger shall be compression type.
- .3            Terminals shall be compression type with spade type lugs.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Conductor length for parallel feeders to be identical.
  - .2            Lace or clip groups of feeder conductors at all distribution centres, pull boxes, panel boards and termination points.
  - .3            All exterior wiring to be TECK90 with 1000-volt XLPE insulation.
  - .4            Provide permanent plastic name tag indicating load fed on all cable ends.
-

- .5 All home run wiring shall be done in concealed conduit or box and arrange for openings in walls, ceiling and floors as necessary.
- .6 Electrical Subcontractor shall ensure that all conduits and boxes are installed concealed in brickwork, blockwork, furred out walls, steel stud and wood stud walls, unless specifically permitted. Any conduit installed on surface shall be removed and reinstalled concealed at Electrical Subcontractor's expense. All costs of making good walls and finishes will be borne by Electrical Subcontractor.
- .7 Exposed wiring, where permitted, shall be installed neatly, parallel or at right angles to the building lines.
- .8 No reduction is permitted on neutral conductors.
- .9 Only 2% voltage drop is permitted. Size wires to meet these requirements.

### 3.2 IDENTIFICATION OF CONDUCTORS

- .1 Line voltage conductors in conduit shall be colour coded to identify service voltage. Conductor colours for 120V circuits shall be:

#### 120 Volt

- Phase A Red
- Phase B Black
- Phase C Blue
- Neutral White
- Ground Green

600V conductor colour to be confirmed with the Contract Administrator.

### 3.3 WORKMANSHIP

- .1 Before installing wire, ensure conduit is clean and dry. If moisture present, thoroughly dry out conduit; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type.
- .2 Installation to be free of opens and grounds. Before energization, megger each feeder to ensure that insulation resistance complies with CEC requirements
- .3 Do not install any conductor smaller than #12 AWG gauge, except where specifically indicated otherwise.
- .4 Provide sizes of conductors as required by CEC or as indicated on the drawings. Voltage drop from panels to farthest device must not exceed 2% at full load. Voltage drop from the main distribution to the panel board must not exceed 2%.

**3.4 INSULATION TEST**

- .1 The insulation resistance between wires and between any wire and ground shall not be less than the CEC requirements with all circuits complete and connected. Include tests results in maintenance manual.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

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

**1.2                REFERENCES**

- .1            Canadian Standards Association, (CSA International)

**1.3                SCOPE OF WORK**

- .1            Provide all labour and material to constitute a complete system, equipment grounding and bonding.
- .2            Ground all components of the electrical system in accordance with the requirements of the Canadian Electrical Code, local authorities and, where more stringent, manufacturers requirements.
- .3            Securely and adequately ground all components of the electrical system in accordance with the requirements of the CEC and additional requirements set up in the contract documents.
- .4            The system shall consist of, but not be limited to cables and supports and all necessary materials to provide a complete system.

**Part 2            Products**

**2.1                EQUIPMENT**

- .1            Insulated grounding conductors: green, type RW90.
- .2            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 conductors, connectors, and accessories. Where EMT is used, run ground wire in conduit.
  - .2            All locknuts, connectors and couplings shall be tight fitting and properly cinched, throughout the entire electrical distribution system for grounding and bonding purposes as required by the CEC.
-

- .3 Ground Connections:
  - .1 When making ground and bonding connections, apply a corrosion inhibitor to contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between metals used.
  - .4 All joints between conductors of #6 AWG and larger shall be made with "Cadweld" process. Special permission from Contract Administrator is required where bolted pressure lugs or screw type "Hydent" connectors are installed.
  - .5 All bolted ground connections must be accessible.
  - .6 Install rigid PVC conduit sleeves where ground wires pass through concrete slabs.
  - .7 Connect grounding conductors to motors 10 hp and above or circuits 20A or above, with a solderless terminal and a bolt tapped to motor frame or equipment housing. Connect to smaller motors or equipment by fastening terminal to a connection box. Connect junction boxes to equipment grounding system with grounding clips mounted directly on box or with machine screws. Completely remove paint, dirt, or other surface coverings at grounding conductor connection points so good metal-to-metal contact is made.
  - .8 Install bonding wire in all flexible conduit connected at each end to a grounding bushing by a solderless lug, clamp, cup washer and screw. Soldered joints not permitted.
  - .9 Ground conductors not sized on drawings are to be sized in accordance with local governing electrical authority requirements. Ground conductor size is to be no smaller than requirements specified herein this article or on drawings.
  - .10 Install connectors in accordance with manufacturer's instructions.
  - .11 Protect exposed grounding conductors from mechanical injury.

**3.2 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 the local inspection authority. A report shall be submitted to the Contract Administrator from the testing agency.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator, if provided, during tests.

**END OF SECTION**

---

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Materials for moulded-case circuit breakers, and ground-fault circuit-interrupters.

**1.2                RELATED SECTIONS**

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

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International).
  - .1            CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489 and the NMX-J-266-ANCE).

**1.4                SUBMITTALS**

- .1            Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2            Include time-current characteristic curves for breakers with ampacity of 100 A and over or with interrupting capacity of 25 kA symmetrical (rms) and over at system voltage.

**Part 2            Products**

**2.1                BREAKERS GENERAL**

- .1            Moulded-case circuit breakers and ground-fault circuit-interrupters: to CSA C22.2 No. 5. Ground-fault detection to be provided on breakers indicated on drawings.
- .2            Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3            Common-trip breakers: with single handle for multi-pole applications.
- .4            Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1            Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5            Circuit breakers with interchangeable trips as indicated.
- .6            Circuit breaker manufacturer shall be the same as the equipment which the breaker is being installed. Where equipment manufacturer no longer exists, a suitable equivalent circuit breaker shall be provided.

**2.2                THERMAL MAGNETIC BREAKERS**

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

**2.3            OPTIONAL FEATURES**

- .1    Include:
  - .1    Shunt trip.
  - .2    Auxiliary switch.
  - .3    On-off locking device.
  - .4    Handle mechanism.

**Part 3        Execution**

**3.1           INSTALLATION**

- .1    Install circuit breakers as indicated on drawings.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Materials and installation for fused and non-fused disconnect switches.

**1.2                RELATED SECTIONS**

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

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International).
  - .1            CAN/CSA C22.2 No.4-M89, Enclosed Switches.
  - .2            CSA C22.2 No.39-M89, Fuseholder Assemblies.

**1.4                SUBMITTALS**

- .1            Submit product data in accordance with Section 26 05 00 - Common Work Results for Electrical.

**Part 2            Products**

**2.1                DISCONNECT SWITCHES**

- .1            Heavy-duty, non-fusible, horsepower rated disconnect switch in CSA NEMA 4 enclosure, to CAN/CSA C22.2 No.4 sized as per drawings.
- .2            Provision for padlocking switch in OFF position.
- .3            Mechanically interlocked door to prevent opening when handle in ON position.
- .4            Quick-make, quick-break action.
- .5            ON-OFF switch position indication on switch enclosure cover.

**2.2                EQUIPMENT IDENTIFICATION**

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

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Install disconnect switches.

**END OF SECTION**

---