

**Part 1            General**

**1.1                REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23th 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                CONTRACTOR REQUIREMENTS**

- .1 Comply with all Department of Labour, Workplace and Health requirements at all times.
  - .2 All Contractors shall have a valid Contractors 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).
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- .11 The Contractor 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 Contractor 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 Contractor 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 Contractor 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 Contractor 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 Contractor 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.
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**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 Contractor 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 Contractor's expense.
    - .3 Contractor 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 to be submitted by email, bearing Contractors' signatures. All shop drawings shall be stamped by the Contractor 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 Contractor 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 Contractor 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 any Contractor or Subcontractor 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 Contractor, 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.
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.4 Substitutions:

- .1 Unless otherwise noted on the plans or specifications, substitutions may be allowed by the Contract Administrator, when requested by the Contractor 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, Contractor 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 Contractor.

**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 panels, disconnect switches and motors, with nameplates and labels as follows:
  - .1 Nameplates:
    - .1 Equipment supplied by the non-emergency power system shall be identified using lamicoïd 3 mm matt black finish face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
    - .2 Equipment supplied by the emergency power system shall be identified using lamicoïd 3 mm matt red 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.
- .8 Transformers: indicate tag, capacity, primary and secondary voltages.

### 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.
- .4 Use colour coded wires in communication cables, matched throughout system.

### 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 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.
- .3 The Contractor 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.
- .4 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.
- .5 It shall be the Contractor's responsibility to ensure that all Subcontractors and suppliers of electrical equipment observe the applicable clauses of the electrical specifications.
- .6 In case of differences between Subcontractors regarding extent of work responsibilities, such matters shall be referred to the Contract Administrator through the Contractor. Should any discrepancy between the specification and drawings leave the Contractor 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 Contractor's responsibility to ensure that the more expensive alternate has been included.
- .7 Prior to the Bid, the Contractor 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.
- .8 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 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
    - .1 Sleeves through concrete: schedule 40 plastic, sized for free passage of conduit, and protruding 50 mm.
  - .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
  - .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
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### 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.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 300 mm.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 Above top of counters or counter splash backs: 100 mm.
    - .4 In mechanical rooms: 1400 mm.
  - .3 Panelboards: as required by Code or as indicated.

### 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 Section 01 45 00 - Quality Control.
  - .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: fire alarm system, Security System, PA system, communications.
  - .6 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 Contractor 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 260500
.3	Wires and Cables (0-1000 V)	Section 260521
.4	Outlet Boxes, Conduit Boxes and Fittings	Section 260532
.5	Conduits, Conduit Fastenings and Conduit Fittings	Section 260534
.6	Disconnect Switches - Fused and Non-Fused	Section 262823

**1.2      SYSTEM DESCRIPTION**

- .1 Provide complete electrical power and control connections for mechanical equipment, except as noted herein, or as noted on the drawings.

**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 shall be as shown on the Division 26 drawings.

**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.
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**3.1 CO-ORDINATION**

- .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 Contractor. 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 Contractor, as part of the tender submission, a list of controls and wiring to be provided by the Electrical Subcontractor.

**END OF SECTION**

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**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 or aluminum 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 01 33 00 - Submittal Procedures.

**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.
- .2 Unless otherwise noted, all systems in the building shall be wired in conduit.

**Part 2 Products**

**2.1 WIRES**

- .1 Unless otherwise shown or specified, all conductors shall be 98% conductivity copper 600 volt "RW90" X-link insulated, and be of minimum size #12 AWG.
- .2 Provide cross-linked thermosetting polyethylene (RW90 X-link) type insulation for all fire alarm system conductors. Where run in cable form with outer jacket, insulation rating on individual conductors to be 105 degrees C.
- .3 Wiring drops for luminaires to be copper, #14 AWG flame retardant, heat and moisture resistant, rated at 600 volt, 125 degrees C Insulation.
- .4 All conductors to be copper only, unless otherwise noted.
- .5 Conductors up to #10 AWG may be solid. Conductors #8 AWG and larger shall be stranded, unless specifically mentioned to be solid.
- .6 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.
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- .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 RW90 X-link with 600 volt 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 as arrange for opening walls, ceiling and floors as necessary. The exceptions are:
  - .1 AC90 cables can be used for wiring light fixtures in the accessible suspended ceilings.
- .6 Contractor shall ensure that all conduits and boxes are installed concealed in brick work, block work, furred out walls, steel stud and wood stud walls, unless specifically permitted. Any conduit installed on surface shall be removed and reinstalled concealed at Contractor's expense. All costs of making good walls and finishes will be borne by Contractor.
- .7 Nylon or similar pulling rope only shall be used to pull conductors into metallic and/or non-metallic conduit.
- .8 Exposed wiring, where permitted, shall be installed neatly, parallel or at right angles to the building lines.
- .9 No reduction is permitted on neutral conductors.
- .10 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
- .2 600V conductor colour to be confirmed with the Contract Administrator.
- .2 Loop conductor in a three-way and four-way switching circuit shall be:
  - Brown
- .3 Switch leg conductors of line voltage switches on lighting and any manually controlled plug receptacle circuits shall be colour coded as follows:
  - A Yellow
  - B Orange
  - C Pink

The sequence of colours shall be repeated if more than three switch legs leave a switch box.

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**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 - Electrical.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
  - .1 ANSI/IEEE 837-1989, Qualifying Permanent Connections Used in Substation Grounding.
- .2 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.

**1.4 TESTS**

- .1 Measure the ground grid resistance with an earth test megger. Under no circumstances shall the resistance of the network for under 750V system exceed 5 ohms.

**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 Install #4 AWG bond wire along the full length of cable trays and between separate sections of trays and bond cable tray as required.
- .10 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.
- .11 Install connectors in accordance with manufacturer's instructions.
- .12 Protect exposed grounding conductors from mechanical injury.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00.
- .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 Not Used

**Part 2 Products**

**2.1 SUPPORT CHANNELS**

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

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Secure equipment to masonry, tile and plaster surfaces with lead shields. Use Aluminum shields or as approved by anchoring manufactures recommendations for specific surfaces.
  - .2 Secure equipment to poured concrete with expandable inserts.
  - .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
  - .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
  - .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
  - .6 Fasten exposed conduit or cables to building construction or support system using straps.
    - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller where above 2700mm.
    - .2 Two-hole steel straps to secure surface conduits and cables 50 mm and smaller where below 2700mm.
    - .3 Two-hole steel straps for conduits and cables larger than 50 mm.
    - .4 Beam clamps to secure conduit to exposed steel work.
  - .7 Suspended support systems.
    - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
    - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
  - .8 For surface mounting of two or more conduits use channels at 2 m on centre spacing.
  - .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
  - .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
-

- .11 Luminaires Recessed in T-Bar ceilings shall be supported independent of T-Bar system via aircraft cable or "Gripple" hangers (Toggle or Y-Hook hangers) as manufactured by Cablofil and shall be firmly attached directly to the existing or new roof building structure.
- .12 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.
- .14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's 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 01 33 00 - Submittal Procedures.

**Part 2            Products**

**2.1                SPLITTERS**

- .1            Sprinkler proof, sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2            Connection bars to match required size and number of incoming and outgoing conductors as indicated.
- .3            At least three spare terminals on each set of lugs in splitters 400 A or less.
- .4            No Splitters without approval by Contract Administrator.

**2.2                JUNCTION AND PULL BOXES**

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

**2.3                CABINETS**

- .1            Type E: sprinkler proof, sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2            Type T: sprinkler proof, sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface or flush mounting as required.
- .3            All cabinets shall be sprinklerproof

**Part 3            Execution**

**3.1                SPLITTER INSTALLATION**

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

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

- .1            Install pull boxes in inconspicuous but accessible locations.
  - .2            Mount cabinets with top not higher than 2 m above finished floor.
  - .3            Install terminal block as required in Type T cabinets.
-

- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

**3.3 IDENTIFICATION**

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

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1            CSA C22.1, Canadian Electrical Code (CEC), Part 1.

**Part 2            Products**

**2.1                OUTLET AND CONDUIT BOXES GENERAL**

- .1            Size boxes in accordance with CSA C22.1.
- .2            102 mm square or larger outlet boxes as required for special devices.
- .3            Gang boxes where wiring devices are grouped.
- .4            Blank cover plates for boxes without wiring devices.
- .5            Combination boxes with barriers where outlets for more than one system are grouped.
- .6            All electrical equipment shall be sprinkler proof.

**2.2                SHEET STEEL OUTLET BOXES**

- .1            Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2            102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .3            102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished tile walls.

**2.3                CONDUIT BOXES**

- .1            Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle. This is only allowed in mechanical spaces.

**2.4                OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE**

- .1            Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

**2.5                FITTINGS - GENERAL**

- .1            Bushing and connectors with nylon insulated throats.
  - .2            Knock-out fillers to prevent entry of debris.
  - .3            Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
  - .4            Double locknuts and insulated bushings on sheet metal boxes.
-

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

**END OF SECTION**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 Provide conduit system as indicated herein, on the drawings and as required
- .2 All home run wiring in the building shall be installed in conduits unless otherwise noted.

**Part 2 Products**

**2.1 CONDUITS**

- .1 Rigid Steel Conduit
  - .1 Galvanized with threaded joints and connections.
  - .2 Connections in dry locations: steel or malleable iron lock nuts inside and outside enclosures.
  - .3 Connectors subject to moisture: Liquid and dust tight with insulated throat.
  - .4 Fittings: steel
  - .5 Do not use process piping in lieu of CSA approved conduit.
- .2 EMT Conduit
  - .1 Fittings in dry locations: steel or malleable iron set screw type fastener with insulated throats or non-metallic bushings.
  - .2 Fittings in wet locations: steel or malleable iron in rain tight, compression-type, with insulated throat or non-metallic bushings, this is typical for all exterior connections.
- .3 Flexible Conduit
  - .1 Conduit: spiral wound, interlocking flexible.
  - .2 Connectors: slip-proof insulated throat or non-metallic bushings, steel type.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Flexible Conduit shall be used for line and low voltage circuit connections to all motors or equipment subject to vibration and shall be metal PVC coated water tight, except for lighting fixture drops. Connectors shall be approved for flexible liquid tight conduits.
- .2 Unless otherwise noted, Electrical Metallic Tubing (EMT) shall be utilized in the building.
- .3 Conduit for telecommunication systems shall be a minimum 21mm diameter unless noted as larger.
- .4 Install all conduit and wiring concealed, except where specifically noted otherwise. Do not recess conduit in columns or concrete slabs.
- .5 Where conduit is run exposed, run parallel to building lines. Where conduits are grouped (two or more), space evenly, make bends concentric and mount on racks.



- .6 Lay out conduit to avoid interference with other work. Maintain a minimum clearance of 150mm from steam or hot water piping, etc.
- .7 Slabs on grade: install rigid PVC conduit in the gravel base below concrete slabs. Provide mechanical protection around stub-ups, through slab and extend 150mm beyond concrete. When rigid steel conduit is installed in contact with earth, it shall be protected with tape or asphaltum paint. Extend taping or paint 300mm above finished grade.
- .8 Conduit ends emerging from concrete slab, which are to remain as exposed conduit, shall be rigid galvanized steel. Provide rigid steel oversized sleeve over the exposed PVC portion of conduit.
- .9 All conduit exposed to weather shall be approved for use in those locations and be complete with weatherproof fittings.
- .10 All rigid PVC conduit installed under slab on grade shall include a bonding wire sized as required by Canadian Electrical Code.
- .11 Where used, sleeves shall be c/w proper connectors and plastic bushing (this is particularly important for telecommunications cabling installation.)
- .12 Install a separate ground wire in conduit installed underground or in concrete or masonry slab in contact with the earth.
- .13 Watertight fittings shall be installed in areas exposed to moisture and concrete type fittings in concrete slabs.
- .14 Where conduit is required to be bent, do not heat and do not bend in such a way as to reduce the cross-sectional area at any point.
- .15 For all runs of conduit, do not include more than the equivalent of four 90 degree bends, including bends located immediately adjacent to an outlet box or fitting. Provide pulling elbows, pull boxes and/or junction boxes where necessary.
- .16 Where possible, install conduits so that they are not trapped. Cap turned up conduits to prevent the entrance of any dirt or moisture during construction. If necessary, swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .17 Take extreme care in reaming ends of all conduit to ensure a smooth, interior finish that will not damage the insulation of the wires.
- .18 Use insulated non-metallic bushings on all conduit terminators. Ensure electrical continuity in all conduit systems. All conduits shown exposed in finished areas are to be free of labels and trade marks. Install a 45kg test line in all empty conduits. Conduits and ducts crossing building expansion joints shall have conduit expansion fittings to suit the type of conduit used. Seal conduits with duct seal where conduits are run between heated and unheated areas or into freezers. Where conduits, cables, or cable trays pierce fire separations, seal openings with approved sealing compound.

### **3.2 SLEEVES AND CHASES**

- .1 Sleeves shall be provided and set for conduit passing through foundations, concrete walls and floors. Sleeves shall have sufficient diameter to allow free conduit movement resulting from thermal expansion and contraction. Sleeves installed through foundation walls, beams

and footings shall be installed flush with walls, partitions, floors and ceilings. All sleeves installed below grade shall be caulked with oakum and lead on both sides of the wall. Sleeves in floors where water is present shall be caulked, graphite packing and water proof sealant used.

- .2 Exact locations of conduit stub ups for connection to service equipment, signs etc., shall be checked and verified with the Contract Administrator. Shop drawings shall be issued prior to rough-in and slab being poured.
- .3 No extra claim will be accepted by the Contract Administrator for stub up adjustments as a result of the Contractor not following the checking procedure as described under item 2.
- .4 Adjustments of stub ups shall be carried out to the satisfaction of the Contract Administrator. Damaged surfaces shall be repaired to their original condition. Conduit extension shall comply with Canadian Electrical Code and wires are to be re-pulled.
- .5 For each telecommunication outlet (data, voice, video etc.) provide a corresponding sleeve in every wall leading to the local cable tray to facilitate installation of telecommunication cables.

### **3.3 EMPTY CONDUITS**

- .1 All empty conduits shall be c/w pull wires.
- .2 All conduits stubbed out shall be provided with rubber grommets and end caps.

**END OF SECTION**

---

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No. 100, Motors and Generators.
  - .2 CSA C22.2 No. 145-M1986, Motors and Generators for Use in Hazardous Locations.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC M1-7-1992 or latest revision, Standard for Motors and Generators.

**1.2 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Indicate product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .3 Shop drawings:
  - .1 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.
- .4 Quality Assurance Submittals:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals:
  - .1 Provide maintenance data for fractional horsepower motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**Part 2 Products**

**2.1 FRACTIONAL HORSEPOWER MOTOR**

- .1 Non-hazardous locations: to CSA C22.2 No. 100 and EEMAC M1-7.
  - .2 Hazardous locations: to CSA C22.2 No. 145.
    - .1 Rating: As indicated.
    - .2 Type: As indicated.
    - .3 Bearings: As indicated.
    - .4 Frame size: As indicated.
    - .5 Enclosure: As indicated.
    - .6 Mounting: As indicated.
  - .3 Motor with inherent overheating protectors.
-

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install wiring, flexible connections and grounding.
- .2 Check rotation before coupling to driven equipment.

**3.3 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

---

**Part 1 General**

**1.1 REFERENCES**

- .1 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
  - .1 EEMAC M1-7, Motors and Generators.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for motors. Include product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
  - .1 Overall dimensions of motor.
  - .2 Shaft centreline to base dimension.
  - .3 Shaft extension diameter and keyway, coupling dimensions and details.
  - .4 Fixing support dimensions.
  - .5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.
  - .6 Terminal box location and size of terminals.
  - .7 Arrangement and dimensions of accessories.
  - .8 Diagram of connections.
  - .9 Starting current and relative data necessary for use in design of motor starting equipment.
  - .10 Speed/torque characteristic.
  - .11 Weight.
  - .12 Installation data.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of motors.
- .3 Manufacturer's recommended list of spare parts.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Handle motors with suitable lifting equipment.
- .2 Store motors in heated, dry, weather-protected enclosure.

**1.6 QUALITY ASSURANCE**

- .1 Contract Administrator reserves the right to witness standard factory testing of motors 50 hp and above.

**Part 2 Products**

**2.1 HORSEPOWER MOTOR**

**2.2 MATERIALS**

- .1 Motors: to EEMAC M1-7.
- .2 Lead markings: to EEMAC M2-1.
- .3 Rating: As indicated.
- .4 Motor Type: As indicated.
- .5 Service Factor: 1.15.

**2.3 DESIGN LETTERS**

- .1 Polyphase squirrel cage induction motors design As Indicated.

**2.4 ENCLOSURE**

- .1 Totally enclosed fan cooled.
- .2 Totally enclosed explosion proof for use in: Class as Indicated.

**2.5 INSULATION**

- .1 Class: B or As Indicated.
- .2 Ambient temperature: 40 °C or as indicated.

**2.6 BEARINGS**

- .1 Antifriction type bearings, fitted with readily accessible facilities for lubrication while motor running or stationary.

**2.7 STARTING METHOD**

- .1 All motors shall be Inverter Duty rated.
- .2 Include anchor devices and setting templates.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Dry out motor if dampness present in accordance with manufacturer's instructions.
- .2 Install wiring, flexible connections and grounding.

- .3 Make wiring connections. Use liquid tight PVC jacketed flexible conduit between rigid conduit and motor.
- .4 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.
- .5 Check for correct direction of rotation with motor uncoupled from driven equipment.
- .6 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

**3.2 FIELD QUALITY CONTROL**

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

**END OF SECTION**

**Part 1            General**

**1.1                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Submit product data sheets for compartments. Include product characteristics, physical size and finish.
- .3        Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.
- .4        Submit shop drawings and indicate:
  - .1        Outline dimensions.
  - .2        Configuration of identified compartments.
  - .3        Schematic and wiring diagrams.
- .5        Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .1        Include data for each type and style of starter.

**1.2                EXTRA MATERIALS**

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

**Part 2            Products**

**2.1                GENERAL DESCRIPTION**

- .1        Floor mounting, free standing, enclosed dead front.
- .2        Indoor CSA sprinkler proof enclosure, front mounting.

**2.2                MOTOR STARTERS AND DEVICES**

- .1        Provide new circuit breakers, contactors, overloads, control transformers, relays, start/stop, reset and hand-off-auto selector switches as indicated herein or on the drawings.

**2.3                STARTER UNIT COMPARTMENTS**

- .1        Provide new starter unit compartments as indicated on the drawing to suite the existing MCC
  - .2        External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for padlocks to lock operating handle in "off" position and lock door closed.
  - .3        Hinge unit doors on same side.
-



**2.4 WIRING IDENTIFICATION**

- .1 Match existing.

**2.5 EQUIPMENT IDENTIFICATION**

- .1 Match existing.

**2.6 FINISHES**

- .1 Match existing.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install new starter unit compartments in the existing MCC as indicated on the MCC elevation located on drawing E06.
- .2 Make field power and control connections as indicated.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period.

**END OF SECTION**

---

**Part 1            General**

**1.1                SECTION INCLUDES**

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

**1.2                RELATED SECTIONS**

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

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International)
  - .1            CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2            CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3            CSA-C22.2 No.55-M1986, Special Use Switches.
  - .4            CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20).

**1.4                SHOP DRAWINGS AND PRODUCT DATA**

- .1            Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

**Part 2            Products**

**2.1                SWITCHES**

- .1            15 or 20 A, 120 V, single pole, three-way, or four-way switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.
  - .2            Manually-operated general purpose ac switches with following features:
    - .1            Terminal holes approved for No. 10 AWG wire.
    - .2            Silver alloy contacts.
    - .3            Urea or melamine moulding for parts subject to carbon tracking.
    - .4            Suitable for back and side wiring.
    - .5            White toggle.
    - .6            Framed toggle
  - .3            Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
  - .4            Switches of one manufacturer throughout project.
  - .5            Acceptable materials: Industrial Grade.
-

## **2.2 RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R 5-20R and 6-50R, 125/250V V, 15/20/50 A, U ground, to: CSA-C22.2 No.42 with following features:
  - .1 White urea moulded housing for normal switches. Co-ordinate with Contract Administrator for all unique coloured receptacles.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and riveted grounding contacts.
  - .6 Nylon face
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.
- .4 Acceptable materials: Industrial Grade.

## **2.3 COVER PLATES**

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

- .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .3 Cover plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**END OF SECTION**

**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 01 33 00 - Submittal Procedures.

**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 01 33 00 - Submittal Procedures.
- .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
- .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 breakers to have minimum 22kA symmetrical rms interrupting capacity rating.

**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                SOLID STATE TRIP BREAKERS [DESIGN D]**

- .1            Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time and instantaneous tripping for phase and ground fault short circuit protection.
-

**2.4            OPTIONAL FEATURES**

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

**2.5            ENCLOSURE**

- .1    Sprinkler proof.

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

**Part 2            Products**

**2.1                DISCONNECT SWITCHES**

- .1            Heavy-duty, non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4 sized as per drawings.
- .2            Provision for padlocking in off switch position.
- .3            Mechanically interlocked door to prevent opening when handle in ON position.
- .4            Sprinkler-proof indoors, weatherproof outdoors.
- .5            Quick-make, quick-break action.
- .6            ON-OFF switch position indication on switch enclosure cover.
- .7            Where required (For VFDs) provide an auxiliary contact to break prior to main contacts and interlock with the VFD emergency stop.

**2.2                EQUIPMENT IDENTIFICATION**

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

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Install disconnect switches.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

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

**1.2                RELATED SECTIONS**

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

**1.3                REFERENCES**

- .1            Canadian Standards Association (CSA International)
  - .1            CSA C22.2 No.14-95, Industrial Control Equipment.
- .2            National Electrical Manufacturers Association (NEMA)
  - .1            NEMA ICS 1, Industrial Control and Systems: General Requirements.

**1.4                SHOP DRAWINGS**

- .1            Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Include schematic, wiring, interconnection diagrams.

**1.5                QUALITY ASSURANCE**

- .1            Submit to Contract Administrator one copy of test results.

**Part 2            Products**

**2.1                AC CONTROL RELAYS**

- .1            Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2            Convertible contact type: contacts field convertible from NO to NC, electrically held solid state. Contact rating: as required.

**2.2                RELAY ACCESSORIES**

- .1            Standard contact cartridges: normally-open - convertible to normally-closed in field.

**2.3                OPERATOR CONTROL STATIONS**

- .1            Enclosure: CSA Type 4, flush mounting:

**2.4                PUSHBUTTONS**

- .1            Illuminated, heavy duty oil tight. Operator flush type, as indicated. With 1-NO and 1-NC contacts rated at as required.

**2.5                EMERGENCY STOP PUSHBUTTONS**

- .1            Illuminated, heavy duty oil tight. Operator flush type, as indicated. With 1-NO and 1-NC contacts rated at as required ,operator and contact block included.
-



- .2 Jumbo Red Operator.
- .3 Push to operate, key only to reset.
- .4 Lamicaid, large white letters on red background; stating " Equipment Emergency Stop".

## **2.6 SELECTOR SWITCHES**

- .1 Maintained 3 position labelled as indicated heavy duty oil tight, operators standard, contact arrangement as indicated.

## **2.7 INDICATING LIGHTS**

- .1 Heavy duty Oil tight, full voltage, LED type, as indicated.

## **2.8 CONTROL AND RELAY PANELS**

- .1 CSA Type sprinklerproof sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

## **2.9 CONTROL CIRCUIT TRANSFORMERS**

- .1 Single phase, dry type.
- .2 Primary: 208 V, 60 Hz ac.
- .3 Secondary: 24 or 120 V, AC. As required
- .4 Rating: VA rating as shown.
- .5 Secondary fuse: rated as required.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install as required.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

**END OF SECTION**

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