

**PART 1 General**

**1.1 REQUIREMENTS**

- .1 The General Conditions of the Contract, Supplementary General Conditions, General Requirements, Instructions to Bidders and Form of Tender, are hereby made part of this Section.

**1.2 SECTION INCLUDES**

- .1 This Section covers items common to Sections of Electrical Contractor. This section supplements requirements of Division 1.
- .2 Provide complete and fully operational electrical systems with facilities and services to meet requirements described herein, as shown on the drawings, and in complete accord with applicable codes and ordinances.
- .3 Only those items that are specifically indicated as not in contract (N.I.C.) will be omitted.
- .4 Contract documents of this Division are diagrammatic and approximately to scale, unless detailed otherwise. They establish scope, material and installation quality, and are not detailed installation instructions.
- .5 Follow manufacturers' recommended installation details and procedures for equipment supplemented by details given herein and on plans subject to approval of the Consultant.
- .6 Examine all drawings to ensure that work under this Division can be properly installed without interference.
- .7 Where discrepancies, ambiguities, obvious omissions or errors have been made in drawings and specifications, it shall be the responsibility of the contractor to clarify same prior to tender closing. No allowance will be made after contract award for any expense incurred by him for having to adjust his work to properly conform.

**1.3 CODES AND STANDARDS**

- .1 Do complete installation in accordance with the 2012 Canadian Electrical Code, Saskatchewan Human Rights Accessibility Standard, local by-laws and utility requirements. Work involving fire protection shall be in accordance with the Underwriter's Laboratory of Canada, National Building Code, and National Fire Protection Code.
- .2 The electrical installation shall comply with all Sask Power requirements and regulations.
- .3 In the event of any inspection authority requesting deviation from the design, notify the Consultant and obtain approval before proceeding with any change.
- .4 In no instance, shall the standard established by the drawings and specification be reduced by any code or ordinance. All references to codes and standards shall be to the latest edition.

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

- .1 Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Connect to equipment furnished in other Divisions and by Owner including start-up and test.
- .3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .4 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 all aspects of its care and operation.

#### **1.5 VOLTAGE RATINGS**

- .1 Operating voltages: to CAN3-C235-83.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

#### **1.6 PERMITS, FEES AND INSPECTION**

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Consultant.

#### **1.7 MATERIALS AND EQUIPMENT**

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 All goods and materials shall be new and carry CSA approval seal. Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the Consultant and the Electrical Inspection Department.
- .3 All fire alarm equipment shall carry ULC approval seal.
- .4 No deviation from specified materials shall be allowed, except where alternative materials have been specifically accepted in writing.

- .5 Where materials are not directly specified by catalogue number and manufacturer's name, a high industry specification grade product shall be provided. The Consultant shall be the sole judge of whether this standard is being met.
- .6 All references to known standard specifications shall mean and intend the latest edition of such specifications.
- .7 Each major component of equipment shall have manufacturer's name, address, catalogue and serial number in a conspicuous place.
- .8 Upon request, provide a complete list of all materials and their manufacture. The contractor will be required to use the materials indicated. Changes in manufactures at a future date will not be acceptable.
- .9 Factory assemble panels and component assemblies.

## **1.8 WORKMANSHIP**

- .1 All work under this Division shall be executed in a workmanlike and substantial manner, neat in its mechanical appearance and arrangement.
- .2 A competent representative shall constantly supervise the work of this Division from beginning to completion and final acceptance. So far as possible, the same supervisor and workmen shall be employed throughout the project's duration.
- .3 Material and workmanship not meeting the standard intended and required by this specification shall, upon instruction from the Consultant, be properly replaced without further charge or consideration.

## **1.9 ELECTRICAL DRAWINGS**

- .1 They indicate the general location and route of conduit and cable to be installed. Conduit shall be installed in coordination with other services. These include both new and existing services. Where space is indicated for future equipment or plant use, leave space clear.
- .2 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to the satisfaction of the Consultant at no extra cost.
- .3 Ceiling and floor outlet symbols are scaled to centre line of symbol; symbol does not indicate the size or shape. Mounting height shall be measured to the lowest point on ceiling mounted equipments, and above finished surface for wall mounted equipment.
- .4 Wall outlets are scaled to the perpendicular centre line of the symbol. Mounting heights for all wall mounted outlets shall be measured to the horizontal centre line.

## **1.10 WORK PROVIDED FOR OTHER DIVISIONS**

- .1 Provide information as to the location and exact size of all openings through floors and walls.
- .2 Provide electrical connections, circuit protection and disconnect devices for all equipment supplied by other Divisions, including the Owners. Provide motor starters, disconnect switches, thermal switches, etc., for motors supplied by the Mechanical Division. Special

control equipment being supplied by Mechanical Division shall be installed and wired by that contractor.

#### **1.11 WORK PROVIDED BY OTHER DIVISIONS**

- .1 Installation and framing of all openings in walls or floors larger than 150 mm diameter, or rectangular, with one dimension greater than 150 mm.
- .2 Openings in millwork for electrical outlets and conduits.
- .3 Painting of all panelboard and communication panel trims to match colour scheme where exposed in finished areas.

#### **1.12 WORK NOT PROVIDED BY THIS DIVISION**

- .1 Control wiring below 50V for Mechanical Control equipment beyond terminal section of each motor control centre or motor starter, unless specifically indicated otherwise.

#### **1.13 COORDINATION WITH OTHER DIVISIONS**

- .1 Cooperate fully with the General Contractor, consultant, and owner and other trades of electrically operated equipment to ensure proper arrangement of and provision for all electrical equipment.
- .2 Where outlets or equipment may affect architectural or site treatment desired, contact Consultant and for instructions or detailed drawings.
- .3 Refer to other Divisions including mechanical, millwork, owner supplied equipment, etc, for electrical work in connection with these drawings and specifications.
- .4 Location of lighting outlets and receptacles in mechanical or equipment rooms and similar areas shall be finalized during construction to give optimum arrangement. The Consultant shall approve final location before installation.
- .5 Supply and install all motor connections, including starters and overload protection and disconnecting devices at motors where required. All motor driven equipment shall be provided with a lockable disconnecting device.
- .6 Supply and install complete wiring requirements for full voltage in-line devices on single phase equipment such as thermostats, multi-speed switches for unit heaters, force flows, cabinet heaters, etc.
- .7 Cutting of openings for electrical outlets in millwork and other similar types of custom-made equipment shall be done by the supplier of this equipment, or Division 6.
- .8 Check other Divisions to ensure that suitable provisions have been provided for all motors. It is possible that some motors may vary in size, numbers and characteristics, depending on the equipment manufacturer's specific requirements. Any variations in this regard will not constitute cause for further consideration. The mechanical coordination schedule supplied on the drawings shall be updated with nameplate specifications.
- .9 Assume full responsibility for layout of this work, and for any damage caused the Owner or other Divisions by improper location or carrying out of this work.

- .10 Before commencing work, examine the work of other Divisions, and report at once any defects or interference affecting the work under this Division, or the guarantee of same.
- .11 Location of lighting outlets and receptacles in mechanical or equipment rooms and similar areas shall be finalized during construction to give optimum arrangement. The Consultant shall approve final location before installation.
- .12 Allow for all hoisting and setting of material and equipment.

#### **1.14 OWNER SUPPLIED EQUIPMENT**

- .1 Connect all electrically operated equipment supplied by the Owner, as designated on the drawings.
- .2 Reconnect all existing electrical services from new and existing electrical sources modified by the work of this contract.

#### **1.15 INSPECTION AND TESTING**

- .1 During construction and up to final acceptance, make accessible any equipment or wiring for inspection purposes.
- .2 All electrically operating equipment shall be left as a complete installation in perfect operating condition, and receive final test in the presence of the Consultant.
- .3 Ensure that all circuitry is properly tested and meets the CSA Ground Resistance Requirements. A 600 volt megger or hi-pot procedures shall be used for all such tests.
- .4 On the request of the Consultant, a staff supervisor shall be made available to assist in this inspection work.
- .5 Acceptance tests and commissioning shall be conducted for systems and/or equipment where indicated in the specifications. Acceptance tests shall include, but not be limited to, the following Sections:
  - .1 260521 - Wires and Cables (0-1000 V)
  - .2 260528 - Grounding – Secondary
- .6 Acceptance tests shall meet requirements as required by manufacturer, as outlined in ANSI – NETA 2007 and additional requirements described on drawings and specified herein. All tests shall be documented as per ANSI – NETA 2007 standards and shall include testing results, testing date, testing technician and representative present.
- .7 Certification of all acceptance tests and commissioning shall be submitted to the Consultant for approval. Tests not conducted to the satisfaction of the Consultant shall be repeated, and no further costs will be considered. Written documentation bearing name and signature of Contractor, Consultant and Owner's personnel present during acceptance tests shall be included in certification reports.

#### **1.16 SHOP DRAWINGS**

- .1 Submit shop drawings, where specifically called for, or as requested. Shop drawings shall show detailed dimensional and technical information, and shall properly describe each piece of equipment. Where applicable, shop drawings shall include complete schematics and wiring diagrams. These shop drawings shall be sufficiently detailed to permit the Owner's

technicians to trouble-shoot and repair the equipment. Equipment shall not be ordered and/or fabricated until shop drawings have been reviewed by the Consultant. Shop Drawings shall include, but not be limited to the following Sections on systems and equipment:

- .1 262726 – Wiring Devices
  - .2 262821 - Molded Case Circuit Breakers
  - .3 262823 – Disconnect Switches – Fused and Non-Fused
- .2 Review of shop drawings shall be for general design, arrangement and appearance only. This Division shall check and correct, if necessary, all manufacturer's drawings before submitting, and shall so indicate on each copy, along with a dated approval stamp. All shop drawings must bear an approval stamp and be signed by the Contractor. This review does not relieve this Division from the responsibility for the final installation being correct in all detail, and fully acceptable to the Consultant.
  - .3 Refer to General Conditions of the Contract.
  - .4 Provide nine (9) printed copies and one PDF copy for each Section. Each shop drawing shall be complete with a cover page with the following information:
    - .1 Specification Section and name
    - .2 Project name, Owner's name and address
    - .3 Number of pages in submittal
    - .4 Contractor and Supplier's name and contact information
    - .5 Approval stamps with room for Consultant's stamp
  - .5 Shop drawings for complementary systems and/or equipment shall be submitted at the same time. Partial submittals of related equipment will be rejected or held until all other related shop drawing information has been submitted (i.e. submit all shop drawings for power equipment at the same time). Submittals of shop drawings that are incomplete will be rejected.

## **1.17 CHANGES**

- .1 Where changes to design occur, materials shall be priced at published standard trade net cost. Labour shall be established by N.E.C.A. units. The maximum labour rate shall not exceed the prevailing union rate, and an average of eight men. The eight men shall consist of one foreman, three journeymen, two 4th year apprentices, one 3rd year apprentice and one 2nd year apprentice. Non-productive labour, estimating, material handling, supervision, telephone, storage, tools, etc., shall not exceed 30% of the above average labour rate. Payroll burden shall not exceed 40% of the above total, and mark-ups for overhead and profit shall be in accordance with the general and supplementary conditions.
- .2 Changes to design involving an extra net difference shall be calculated on the same basis as indicated above, but the mark-up shall only apply to the net difference.
- .3 Deletions only shall be credited with a minimum mark-up of 5%.
- .4 Submit complete itemized breakdowns of all extras, deletions, and changes to the Consultant. Breakdown to include quantities, unit costs and extensions. If requested, support claim by certified copies of supplier's invoices.

- .5 The right is reserved to move equipment 3000mm from location shown without further charge or consideration, provided that such re-location is requested prior to finish being applied.

#### **1.18 CONSULTANT PRICES**

- .1 Electrical progress claims shall be made on Contractor Progress Report provided by the Consultant. The Electrical contract price shall be broken down into twelve (12) parts to facilitate assessment of work done and material supplied. This progress claim shall be submitted simultaneously to the General Contractor and the Consultant, the latter case in duplicate. Refer to General Conditions.
- .2 The breakdown shall indicate labour and material to the nearest dollar. Overhead, profit and job expense shall be apportioned to all parts. The breakdown shall be as follows:
- .1 Main services
  - .2 Distribution/Panels
  - .3 Conduit and boxes
  - .4 Wire and cable
  - .5 Motor control
  - .6 Wiring devices
  - .7 Lighting fixtures and lamps
  - .8 Communications systems
  - .9 Security Systems
  - .10 Fire Alarm System
  - .11 Specials
  - .12 Miscellaneous - 8% maximum
  - .13 Extras and credits.

#### **1.19 OPERATING INSTRUCTIONS AND SERVICE MANUALS**

- .1 Upon completion of the installation, provide three (3) complete and comprehensive identical sets of operating and maintenance manuals. Refer top Section 01 78 00 – Closeout Submittals
- .2 The Consultant shall review the operating and maintenance manuals and approve same prior to the manuals being sent to the Owner.
- .3 The operating and maintenance manuals shall include but not be limited to the following information:
- .1 Certification reports.
  - .2 Documentation indicating Owner's receipt of operating instructions.
  - .3 Complete list of all materials turned over to the Owner c/w receipts for same.
  - .4 Shop drawings properly indexed and contained in suitably sized envelopes.
  - .5 Schematic drawings for all systems indexed and contained in suitably sized envelopes.
  - .6 Catalogue brochures for panelboards, wiring devices, light fixtures, fire alarm, etc.
  - .7 Certificate of Owner's electrical equipment training.
  - .8 Acceptance Test reports.

The above information shall be bound in black, hard-backed, three-ring, letterhead size binders. Incomplete or poorly reproduced manuals will be rejected.

- .4 Maintain, on a daily basis, a complete set of marked-up prints as as-built drawings that show in complete detail the final arrangement and location of all electrical components and the interconnecting wiring. All riser conduits, panel feeds, conduit runs over 200 amp and main communications shall be marked on plans. These are to be maintained in a neat and substantial manner, so as to properly and fully illustrate the way in which the installation has been completed.
- .5 The Owner's personnel shall be instructed in the operation and maintenance of miscellaneous equipment for a total of two (2) hours.
- .6 The above instructions shall be given by personnel experienced in the operation of the particular system or equipment. Each item or type of equipment, and all controls, shall be operated in the presence of the Owner's personnel to ensure their understanding of equipment function and individual working parts. The Owner reserves the right to set the period or periods during which the instruction shall be given. The contractor shall submit a program of instruction for approval by the Owner.
- .7 Operating and maintenance manuals shall include written documentation bearing name and signature of Owner's personnel who received the above instructions.
- .8 Operating and maintenance manuals, as well as all Owner instructions, shall be complete before substantial completion (as outlined by the Builders' Lien Act) will be considered. Also, preliminary maintenance manuals must be submitted prior to 70% completion. No further progress payments will be permitted until these preliminary maintenance manuals have been submitted and approved.

#### **1.20 STORAGE AND PROTECTION**

- .1 Maintain and protect all work provided under this Division. Store all materials within a protected enclosure to prevent exposure to weather or construction dirt.
- .2 Protect all finished and unfinished work of this and other divisions from damage during the course of construction. Cover floors and other surfaces, if necessary. Any damaged work or finishes shall be repaired or replaced without further charge to the Owner.

#### **1.21 WARRANTY**

- .1 All materials and workmanship shall be guaranteed for a period of one year from date of substantial completion. The only exceptions are incandescent lighting which shall be guaranteed for a period of four (4) months only.
- .2 Properly repair and replace all defective work and other work which becomes defective during the term of warranty.
- .3 Service on equipment or systems critical to the Owner's operation shall be provided on an emergency basis which may necessitate overtime and service outside of normal working hours. The contractor shall ensure that all suppliers comply with this requirement.

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

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.



- .2 Control wiring and conduit is provided by the Electrical Contractor except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23 and shown on mechanical drawings.

### 1.23 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- .2 Ensure that all overcurrent devices provided in this renovation are coordinated with existing overcurrent devices.

### 1.24 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint indoor switchboards and distribution enclosures light grey to EEMAC 2y-1-1958.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

### 1.25 ABBREVIATIONS

- .1 Abbreviations used in this specification are common to and in general use within the related trades.

### 1.26 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
- .2 Nameplates:

Lamecoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

#### 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

- .3 Labels: Embossed plastic labels with 6 mm high letters unless specified otherwise.
- .4 Wording on nameplates and labels to be approved by Consultant prior to manufacture.

- .5 Allow for average of twenty-five (25) letters per nameplate and label.
- .6 Identification to be English.
- .7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .8 Identify equipment with Size 3 labels engraved "ASSET INVENTORY No. \_\_\_\_". Number as and if directed by Consultant.
- .9 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .10 Terminal cabinets and pull boxes: indicate system and voltage.
- .11 Branch circuit identification shall be provided on all plug-in type receptacles and local switches, and shall be identified by a clear 12mm laminated marker tape with contrasting black lettering.
- .12 The cover plates for all receptacles fed from the ground fault interrupters shall also contain the wording "G.F.I."
- .13 The circuits controlled by all light switches shall be neatly printed with waterproof ink on the side of the switch outlet box so that the panel and circuit number are clearly legible when the coverplate is removed. It shall not be necessary to remove the switch from the outlet box in order to read the panel or circuit number.

## **1.27 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Connections in equipment shall be made Phase 'A', 'B', 'C', from left to right when viewing wiring from front or accessible direction.
- .4 Colour coding shall be carried through from incoming utility supply down to and including panels, and shall be as follows:
  - .1 Incoming utility service lines shall be identified by Red - Phase 'A'; Black - Phase 'B'; Blue - Phase 'C'; with colour coded PVC tape.
  - .2 Switchgear buswork in each switchboard and unit substation cubicle shall be banded with 3M tape identified in accordance with service lines colour coding. In addition, where neutral bus is introduced, it shall be banded white. Ground bus shall be banded green.
  - .3 Feeder and sub-feeder bus or conductors shall be banded as above.
  - .4 Lighting and power panels shall conform to the Canadian Electrical Code, and shall have main bus banded with tape as follows:

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

- .5 Colour code: to CSA C22.1. Use colour coded wires in communication cables, matched throughout system.

## **1.28 CONDUIT AND CABLE IDENTIFICATION**

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

	<b>Prime</b>	<b>Auxiliary</b>
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

## **1.29 WIRING TERMINATIONS**

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

## **1.30 MANUFACTURERS AND CSA LABELS**

- .1 Visible and legible, after equipment is installed.

## **1.31 WARNING SIGNS**

- .1 As specified and to meet requirements of Electrical Inspection Department and Owner.
- .2 Decal signs, minimum size 175 x 250 mm.

## **1.32 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with drawings and specifications.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and electrical on latch side of door.

**1.33 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.

**1.34 LOAD BALANCE**

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

**1.35 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: 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 to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

**1.36 MATERIAL TO BE TURNED OVER TO THE OWNER**

- .1 Materials as indicated in various sections of this specification shall be turned over to the Owner. Obtain a signed receipt for each item turned over to the Owner. Include receipts in the operating and maintenance manuals.

**1.37 SCHEDULING OF WORK AND DEMOLITION**

- .1 The contractor shall make a thorough study of the main distribution and communications systems to ensure the method required to maintain all existing building services during the construction period. All changeovers shall be done during a period of the day found satisfactory to the Owner.
- .2 All outages shall be less than two (2) hours in duration. The contractor shall submit the method and procedure of all changeovers for approval by the Consultant and the Owner a minimum of ten (10) working days in advance.

- .3 The existing fire alarm system shall be maintained in a fully operational state while modifications and additions to the system are installed.
- .4 Decommission and related demolition work related to the existing Jet Fuel Pump and Pump Controls as noted on the drawings.
- .5 Relocate and reconnect existing exterior wall pack lighting fixtures, existing obstruction lighting fixture and existing special purpose receptacle outlets as indicated on the floor plans.
- .6 All salvaged materials shall remain the property of the Owner unless otherwise noted. Materials that are turned over to Owner shall be stockpiled as per the Owner's instruction.
- .7 Refer to the overall project schedule for further scheduling requirements.

**1.38 SITE EXAMINATION**

- .1 The contractor shall visit the existing construction site during the tendering period to familiarize himself with the construction conditions and electrical work provided to date. The contractor shall thoroughly satisfy himself that the work contained in these drawings and specifications can be carried out and that all costs have been included in the tender submitted.

**1.39 CUTTING AND PATCHING**

- .1 Should any cutting or repairing of either unfinished or finished work be required, the contractor shall employ the particular trade whose work is involved, to do such cutting and patching, and shall pay for any resulting costs.
- .2 All holes within buildings shall be fire stopped when penetrating a fire rated structure.

**1.40 MATERIAL SAFETY DATA AND HAZARDOUS MATERIALS**

- .1 The Contractor shall provide material safety data sheets on all materials prior to shipping materials to site. These data sheets shall be submitted in triplicate to the Owner.
- .2 The Contractor shall coordinate and provide necessary information for the Owner's "Work Place Hazardous Material Information System".

**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      CSA C22.1-12, Canadian Electrical Code, Part 1, 2012
- .2      Canadian Standards Association (CSA International) (Latest Editions)
  - .1      CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2      CSA C22.2No.65, Wire Connectors.
- .3      Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1      EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .4      National Electrical Manufacturers Association (NEMA)

**PART 2      Products**

**2.1            MATERIALS**

- .1      Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2      Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors #10 AWG or less.
- .3      Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1      Connector body and stud clamp for round copper conductors.
  - .2      Clamp for round copper conductors.
  - .3      Stud clamp bolts.
  - .4      Bolts for copper conductors
  - .5      Sized for conductors as indicated.
- .4      Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

**PART 3      Execution**

**3.1            INSTALLATION**

- .1      Remove insulation carefully from ends of conductors and:

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

**END OF SECTION**

**PART 1 General**

**1.1 RELATED SECTIONS**

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

**1.2 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 2012
- .2 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.
- .3 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

**1.3 PRODUCT DATA**

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

**PART 2 Products**

**2.1 BUILDING WIRES**

- .1 Conductors: stranded for #10 AWG and larger. Minimum size: #12 AWG for branch circuit wiring and #14 AWG for fire alarm signaling systems.
- .2 Copper conductors: sizes as indicated, with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU90.
- .3 All conductors # 12 AWG to # 8 AWG shall be rated for minimum 600V RW-90 XLPE. Conductors # 6 AWG and larger shall be rated for minimum 1000V RW-90 XLPE. All conductor for motor feeds from variable frequency drives, shall be rated for minimum 1000V RW-90 XLPE. Wiring in channel back of fluorescent fixtures shall be 600 volt Type GTF or TEW. Size, grade of insulation, voltage and manufacturer's name shall be marked at regular intervals.
- .4 Conductors utilized in conduit runs under slab on grade or in underground conduit shall be Type 'RWU-90'.

**2.2 TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
  - .1 Type: ethylene propylene rubber.
  - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V to 1000V as noted above.



- .3 Inner jacket: polyvinyl chloride material
- .4 Armour: interlocking aluminum
- .5 Overall covering: polyvinyl chloride material
- .4 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 300mm centers.
  - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .5 Connectors:
  - .1 Watertight, approved for TECK cable.

### **2.3 ARMoured CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90
- .3 Armour: interlocking type fabricated from aluminum strip
- .4 Type: ACWU90 – PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .5 Connectors: as required.

## **PART 3 Execution**

### **3.1 INSTALLATION OF BUILDING WIRES**

- .1 All 120/208 volt receptacle and lighting circuits that exceed 30 metres in length from the panel shall be fed with #10 AWG conductors.
- .2 All branch circuit conductors shall be sized to limit the voltage drop to a maximum of 3% based on the circuit load of 80% of the circuit protective device.
- .3 Termination for #8 AWG and larger shall be by means of approved solderless connector lug. For parallel conductors, a common lug with separate termination for each conductor shall be employed.
- .4 Conductors up to and including No. 6 AWG gauge shall be spliced with nylon insulated expandable spring type connectors. Large conductors shall be spliced together using inline compression sleeves. Provide sufficient length for joint remake, and no less than 200 mm spare length.
- .5 Wiring in cabinets, pull boxes, panels and junction boxes shall be neatly trained and held with nylon cable ties.

- .6 Conductors shall be tag identified where passing through junction boxes.

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

- .1 Install cables.
- .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0-1000V.
- .3 All cables shall be installed in accordance with the manufacturers recommendations, in suitable cable tray as specified within the specifications.
- .4 The cables shall be terminated at the supply end on a non-ferrous metallic plate and at the load end on a non-metallic rigid fibre board plate. The cable sheaths shall be bonded at the supply end only.
- .5 All cable installed in cable tray shall be installed at one diameter spacing.
- .6 Teck cabling shall be used only where noted on plans.

### **3.3 INSTALLATION OF ARMoured CABLES**

- .1 Group cables wherever possible.
- .2 Armoured cables may be used for connection between above ceiling distribution outlet boxes and wiring devices within the partitions and at system furniture terminal connections.
- .3 Where armoured cabling is allowed, it may not be run horizontally through walls.
- .4 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors – 0 - 1000V.
- .5 Connectors: as required.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials and installation for connectors and terminations.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 Submittal Procedures.
- .2 Section 26 05 33 - Raceway and Boxes for Electrical Systems.

**1.3 REFERENCES**

- .1 Canadian Standards Association (CSA International)

**1.4 PRODUCT DATA**

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

**Part 2 Products**

**2.1 CONNECTORS AND TERMINATIONS**

- .1 Copper compression connectors to CSA as required sized for conductors.
- .2 Splices shall be used only where specifically noted on plans. All splicing shall be compression type splices. Verify splicing method with consultant prior to completing work.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required

**END OF SECTION**

**PART 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 Section 27 00 00 – Communication Requirements

**1.2 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 2012
- .2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
  - .1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.

**PART 2 Products**

**2.1 EQUIPMENT**

- .1 Grounding conductors: bare stranded copper, minimum #12.
- .2 Insulated grounding conductors: green. Exposed sheath shall be FT4, if located in a plenum space the sheath shall be FT6.
- .3 Ground bus: copper, complete with insulated supports, fastenings, connectors.
- .4 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.
- .5 All ground conductors shall be bare or insulated, stranded, medium hard drawn copper wire. All insulated ground wires shall be green.
- .6 Exposed copper shall be cleaned to a bright surface, and shall be finished with two coats of clean, insulating varnish.
- .7 All connections to the ground bus or risers shall be thermowelded, or shall utilize compression connections. Clamp type connections shall only be allowed to individual pieces of equipment.

- .8 Where bonds are covered with soil, the conductors are to be coated with anti-corrosion compound before compression connector is applied. All bonding shall be done with 'C' tap and lug compression connectors.

### **PART 3 Execution**

#### **3.1 INSTALLATION GENERAL**

- .1 Electrical equipment and wiring shall be grounded in accordance with the Canadian Electrical Code, and local inspection authority's rules and regulations.
- .2 The existing building ground network shall remain unchanged.
- .3 All metallic raceways and conduits for communications, cable, and conductors shall be grounded.
- .4 All motors with flexible connections shall have separate ground wire run bridging the flexible connections. This ground wire shall be run from the motor back to the nearest junction box or motor control centre where the termination can be readily inspected. Insulation for this wire shall be green.
- .5 Lay-in trays and feeder conduits shall be connected to the ground bus.
- .6 All 120/208 volt and 347/600 volt wiring shall be run in rigid conduit, or may be run in EMT if a separate ground wire is run from the panel or switch to each piece of equipment. The ground conductor shall be connected to the housing of each piece of equipment and the outlet box. Where rigid conduit is employed, all terminations of these conduit runs are to be with double locknuts, grounding bushings with jumper wires run between the bushing lug and the box or panel enclosure. Care shall be taken in conduit runs to ensure that all rigid pipe couplings and fittings are wrench tight.
- .7 All panel feeds at 600 volt and 208 volt shall include a building network ground conductor.
- .8 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .9 Install connectors in accordance with manufacturer's instructions.
- .10 Protect exposed grounding conductors from mechanical injury.
- .11 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .12 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .13 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .14 Structural steel and metal siding to ground by welding copper to steel.

- .15 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections unless indicated otherwise.
- .16 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .17 Soldered joints not permitted.
- .18 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .19 Ground secondary service pedestals.

### **3.2 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral of secondary systems.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, duct systems, frames of motors, starters, control panels, steel work, ladders and distribution panels.

### **3.4 FIELD QUALITY CONTROL**

- .1 Perform tests described herein and in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.
- .4 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .5 Connections to neutral points and equipment shall be made with thermowelds or brass, bronze or copper bolts and connectors.
- .6 Equipment grounds and transformer system grounds shall be connected to the building grounding network. All non-current carrying metallic parts of equipment shall be connected to the ground network.

**END OF SECTION**

**PART 1        General**

**1.1            REFERENCE**

- .1        CSA C22.1-12, Canadian Electrical Code, Part 1, 2012

**PART 2        Products**

**2.1            SUPPORT CHANNELS**

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

**PART 3        Execution**

**3.1            INSTALLATION**

- .1        Secure equipment to poured concrete with expandable inserts.
- .2        Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3        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.
- .4        Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5        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.
  - .2        Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3        Beam clamps to secure conduit to exposed steel work.
- .6        Suspended support systems.
  - .1        Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2        Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .7        For surface mounting of two or more conduits, use channels spaced as required by C22.1.
- .8        Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .12 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**



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**PART 1 General**

**1.1 REFERENCE**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 2012

**PART 2 Products**

**2.1 SPLITTERS**

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs 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.

**2.2 JUNCTION AND PULL BOXES**

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

**2.3 CABINETS**

- .1 Sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

**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 / bix block where indicated in cabinets.
- .4 Only main junction and pull boxes are indicated. Provide others as required by code. 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 01 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase, Emergency or Normal power.

**END OF SECTION**

**PART 1 General**

**1.1 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 2012

**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 Provide blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.
- .6 Each outlet box installed in steel stud and gyproc walls shall be mounted on Caddy #BHA, series SGB or TSGB screw gun brackets. Wood strapping with steel studs shall not be utilized for supporting outlet boxes
- .7 Use condulets where 90° turn required on wall mounted conduit. They shall be of the type where cover screws do not enter the wire chamber and covers are left accessible.
- .8 Each outlet box installed in acoustic tile ceilings shall be mounted on double Caddy "Tee Bar Hanger" #512 in such a manner that the outlet box will not twist in any direction.
- .9 Where boxes are surface mounted in unfinished areas, such as furnace or boiler rooms, stamped galvanized steel 100 mm square box to accept #8300 series raised covers shall be used.
- .10 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS' with threaded hubs and vapourproof covers.
- .11 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.
- .12 Standard octagon boxes shall be 100mm diameter, 53mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .13 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.
- .14 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.
- .15 Set boxes plumb and level within 6mm of finished surface. Mats not permitted.
- .16 Where required, provide voltage separation boxes.

## **2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel 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 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

## **2.3 CONCRETE BOXES**

- .1 Electro galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.4 CONDUIT BOXES**

- .1 Outdoor or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.
- .2 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components. Boxes shall be hot dip galvanized to ASTM A 924(M) designation zinc coating Z180(G60).
- .3 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .4 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.
- .5 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.
- .6 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.
- .7 Where required, provide voltage separation barriers.

## **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.

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**PART 3      Execution**

**3.1            INSTALLATION**

- .1      Support boxes independently of connecting conduits.
- .2      Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3      For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4      Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5      Outlet boxes shall be supported independently of conduit capable of supporting weight of fixture or other device. Conduit entering the back of a box shall not enter the centre knockout.
- .6      For recessed fixtures in suspended ceilings, outlet box shall be accessible when fixture is removed.
- .7      Flexible conduit to fixture shall be minimum 12 mm diameter, and shall not emanate from outlet box cover. Maximum length of flexible conduit from outlet box to fixture shall be 3000 mm. Outlet box for fixture shall not be located above ducts, pipes, etc. Outlet box shall be within 750 mm (vertically) of the fixture.
- .8      Provide and set all special communications type back boxes associated with systems specified under Electrical Divisions.
- .9      In placing outlets, allow for overhead pipes, ducts, etc., and for variation in wall and ceiling finishes, door and window trim, paneling, etc.
- .10     Location of receptacle outlets in equipment rooms shall be finalized during construction to give optimum arrangement. Consultant to approve locations before installation.
- .11     Multi-gang boxes for use with 347 volt switches shall have each gang fully barriered from the next, or multiple single gang boxes may be used, provided they are installed in a neat, orderly fashion. Barriers shall be steel and shall be firmly held in place.
- .12     Attention is directed to special outlet box locations for 347 volt switches requiring wider mount spacing rejection feature.

**END OF SECTION**

**PART 1 General**

**1.1 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 2012
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA C22.2 No. 18-04, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
  - .2 CSA C22.2 No. 45, Rigid Metal Conduit
  - .3 CSA C22.2 No. 56-2004, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-2004, Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit
  - .6 CAN/CSA C22.2 No. 227.3-2004, Flexible Nonmetallic Tubing.

**PART 2 Products**

**2.1 CONDUITS**

- .1 All cabling shall be in conduit unless specifically noted otherwise.
- .2 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .3 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .4 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .5 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .6 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .7 Flexible PVC conduit: to CAN/CSA C22.2 No. 227.3
- .8 Flexible electrical nonmetallic tubing (ENT): to CAN/CSA standard C22.2, No. 227.1 and C22.2 No. 85. NEMA TC-13 Electrical Nonmetallic Tubing.
- .9 Conduit for use in corrosive atmospheres shall be rigid PVC or rigid steel with extruded PVC jacketed. Refer to drawings for areas requiring PVC.
- .10 Condulets shall be of a type wherein cover screws do not enter the wire chamber.
- .11 Flexible conduit connections to all mechanical equipment shall be of 'Sealtite' manufacture.
- .12 Flexible conduit connectors shall be of the insulated throat type.
- .13 Condulets with suitable covers shall be used where condulets are exposed. Each conduit fitting shall be of a type suitable to its particular use, and of a type which will allow installation of future conduits without blocking covers of existing condulets.

- .14 Expansion joints shall be installed with ground jumper.
- .15 All conduits shall be terminated with a suitable bushing.
- .16 Flexible conduit and EMT conduit entering boxes or enclosures shall be terminated with nylon insulated steel threaded bushings, grounded type.

## **2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm diameter to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit / raceway specified. Coating: same as conduit / raceway.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits / raceways.
- .3 Watertight connectors and couplings for EMT. Set-screws are not acceptable. Watertight connectors are required only in Mechanical, Electrical, Communications Rooms.

## **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.5 FISH CORD**

- .1 Polypropylene.

# **PART 3 Execution**

## **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conduits and cables shall be supported, at regular intervals, with corrosion resisting clamps. Lead anchors or expansion bolts shall be used to attach clamps to masonry walls.
- .3 Conduit and cables shall be installed to avoid proximity to water and heating pipes. They shall not run within 150 mm of such pipes, except where crossings are unavoidable, in which case they shall be kept at least 25 mm from covering of pipe crossed.

- .4 Cap ends of all conduits to prevent entrance of foreign matter during construction. Manufactured caps shall be employed.
- .5 Conduit shall be installed as close to building structure as possible so that where concealed, necessary furring can be kept to a minimum.
- .6 Empty conduits, installed under this Division but in which wiring will be installed by others, shall be swabbed out with "Jet Line" foam packs, and be c/w Polypropylene pull wire or polytwine.
- .7 Conduits shall be installed at right angles or parallel to building lines, accurate in line and level.
- .8 Conduit shall not be bent over sharp objects. Improperly formed bends and running threads will not be accepted. Bends and fittings shall not be used together. Proper supports of manufactured channels shall be provided where exposed conduits and cable runs are grouped.
- .9 Under no condition will EMT be allowed exposed within 1200 mm of floor, outdoors, or in areas where explosive, corrosive or moist atmosphere exists.
- .10 Not more than four (4) 90 degree bends or equivalent offsets will be permitted between pull boxes. When maximum number of bends are used, the total run between pull boxes shall not exceed 18 meters..
- .11 PVC conduit shall not pass through a fire partition or floor separation. Where it is necessary for PVC conduits to pass through a fire barrier, a transition to rigid steel conduit shall be provided for 2000mm on either side of the fire barrier.
- .12 Surface mount conduits except where noted otherwise.
- .13 Use rigid PVC conduit in corrosive areas or as indicated on plans.
- .14 Use flexible metal conduit or Teck90 for connection to motors.
- .15 Use liquid tight flexible metal conduit or Teck90 for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .16 Use explosion proof flexible connection for connection to explosion proof motors.
- .17 Minimum conduit size for lighting and power circuits: 21 mm.
- .18 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Mechanically bend steel conduit over 16mm dia.
- .19 Install pull-twine in all empty conduits / raceways and conduits / raceways that are less than 40% filled.
- .20 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .21 Dry conduits out before installing wire.
- .22 Conduits, raceways, cabling shall not run within in-slab concrete floors and ceilings. Any conduit, cable, raceways required to run along the concrete slabs shall be surface runs; not run



in the concrete. Any instances where cabling is required to be run in concrete may be run in rigid PVC conduit or non-metallic flexible raceways, and shall transition to EMT or rigid steel with interfacing connectors or junction boxes being provided as required. This specification contains reference to cast in place conduits. This is only applicable where specifically called for in certain locations within the documents.

- .23 For panels recessed in a finished wall, provide for every six branch circuit spaces and spares, or fraction thereof, one 27mm empty conduit up to furred ceiling space, and one 27mm empty conduit down to floor below, and cap for future wiring.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 meter clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.3 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.4 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25mm concrete cover.
- .7 Organize conduits in slab to minimize cross overs.
- .8 All joints shall be made watertight and stub-ups protected against mechanical damage. Misaligned stub-ups shall be chiselled out and re-bent to conform.
- .9 Expansion joints shall be provided in conduit runs where they cross building expansion joints.

**3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE**

- .1 Run conduits 25mm and larger below slab and encased in 75mm concrete envelope.  
Provide 50mm of sand over concrete envelope below floor slab.

**3.6 CONDUITS UNDERGROUND**

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

**END OF SECTION**

**PART 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.2 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 2012
- .2 Canadian Standards Association (CSA International)
  - .1 CSAC22.2No.26, Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

**PART 2 Products**

**2.1 WIREWAYS**

- .1 Wireways and fittings: to CSA C22 No.26.
- .2 Sheet steel with hinged cover to give uninterrupted access.
- .3 Finish: baked grey enamel.
- .4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

**PART 3 Execution**

**3.1 INSTALLATION**

- .1 Install wireways and auxiliary gutters.
- .2 Keep number of elbows, offsets, connections to minimum.
- .3 Install supports, elbows, tees, connectors, fittings.
- .4 Install barriers where required.
- .5 Install gutter to full length of equipment.

**END OF SECTION**

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**PART 1        General**

**1.1            SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings and product data in accordance with Section 01330 - Submittal Procedures.

**PART 2        Products**

**2.1            REQUIREMENTS**

- .1        Switches and receptacles shall comply with requirements of CSA, U.S. Federal Specification WS896E (switches), WC596F (receptacles) and NEMA Standard WD-1.
- .2        Determine on drawings from the circuit identification given the voltage of the branch circuit from which the device is connected or controlling.
- .3        Switches and receptacles shall be of the same manufacturer.
- .4        Refer to drawing symbol legend for further requirements.

**2.2            SWITCHES**

- .1        15, 20 A, 120 V or 347 V single pole, double pole, three-way, four-way switches.
- .2        Manually-operated general purpose ac switches with following features:
  - .1        Grade: Specification grade
  - .2        Terminal holes approved for No. 10 AWG wire.
  - .3        Silver alloy contacts.
  - .4        Urea or melamine molding for parts subject to carbon tracking.
  - .5        Suitable for back and side wiring.
  - .6        BROWN rectangular decorator rocker type.
- .3        Rocker operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4        Switches controlling motors shall be K.W. (H.P.) rated and approved for motor control service.
- .5        Set switches flush in all finished areas, or in surface box where conduit or wireway is exposed.

**2.3            RECEPTACLES**

- .1        Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
  - .1        Grade: Specification grade
  - .2        BROWN urea molded housing, rectangular decorator style
  - .3        Suitable for No. 10 AWG for back and side wiring.
  - .4        Break-off links for use as split receptacles.

- .5 Eight back wired entrances, four side wiring screws.
- .6 Triple wipe contacts and rivetted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.
- .4 Set receptacles flush in all finished areas, or in surface box where conduit or wireway is exposed

## **2.4 SPECIAL WIRING DEVICES**

- .1 Ground Fault Circuit Interrupter (GFCI) Convenience Outlets:
  - .1 Grade: Specification grade
  - .2 WHITE high impact chemical resistant molded nylon or polycarbonate face.
  - .3 Decora style
  - .4 NEMA 5-15R
  - .5 Suitable for No. 10 AWG, side wired.
  - .6 Have a feed-through capability for protecting downstream on the same circuit.
  - .7 Class A rated with 5 milliamperes ground fault trip level and a 20 ampere feed through rating.
  - .8 'Safe Lock' protection such if critical components are damaged and ground fault protection is lost, power to the receptacle is disconnected.
  - .9 Test and Reset buttons, LED trip indicator light
- .2 Special convenience outlets for specific equipment, straight blade or locking wiring devices, shall be specification grade, identified by the CEMA configuration for the device as indicated on the drawings.

## **2.5 COVER PLATES**

- .1 Cover plates from one manufacturer shall be used throughout project.
- .2 Stainless steel cover plates for wiring devices mounted in flush-mounted outlet box.

## **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 specified in Section 260501- Common Work Results, Electrical or as indicated.
- .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 specified on drawings.

- .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 Co-ordinate with architectural and mechanical drawings for location of all counter tops, millwork and feature walls, to ensure proper location and mounting height.
  - .5 All convenience outlets shall meet tension tests as per CSA requirements, and will be subjected to 'on site' tests during final inspection.
- .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 molded-case circuit breakers, and ground-fault circuit-interrupters.

**1.2 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 2012
- .2 Canadian Standards Association (CSA International).
  - .1 CSA-C22.2 No. 5-02, Molded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

**PART 2 Products**

**2.1 BREAKERS GENERAL**

- .1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 deg C ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .4 Circuit breakers to have minimum of 10,000 A symmetrical rms interrupting capacity rating in breaker panelboards.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .6 New breakers required for installation in existing panels shall be of the same manufacturer and style compatible for the existing panel. IC rating for the new breakers shall match those breakers installed in the panel.

**PART 3 Execution**

**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**END OF SECTION**

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**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 01   Common Work Results - Electrical.

**1.3            REFERENCES**

- .1        Canadian Standards Association (CSA International).
  - .1        CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
  - .2        CSA C22.2 No.39-M89 (R2003), 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        Fusible and non-fusible disconnect switch in CSA Enclosure , size as indicated.
- .2        Mechanically interlocked door to prevent opening when handle in ON position.
- .3        Fuses: size as indicated. Switch fuse units shall be available in 30 through 1200 amp standard industry sizes. They shall be readily removable and interchangeable without modification to bus work or mounting rails
- .4        Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .5        Quick make, quick break action.
- .6        Fusible switches shall be quick-make, quick-break, visible blades, integral handle mechanism, deionizing arc quenchers, front operation, high pressure fuse clips and recessed live parts.
- .7        Operating handles to have provision for padlocking in either 'on' or 'off' position.
- .8        Handle to be marked to clearly indicate switch contact positions.
- .9        Switch fuse units shall be available in 30 through 1200 amp standard industry sizes.



- .10 Shall be readily removable and interchangeable without modification to bus work or mounting rails.

## **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 Common Work Results - Electrical.
- .2 Lamecoid nameplates, approximately 75 mm x 25 mm, shall be provided on front doors of each switch for identification, showing the name and rating.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

**END OF SECTION**